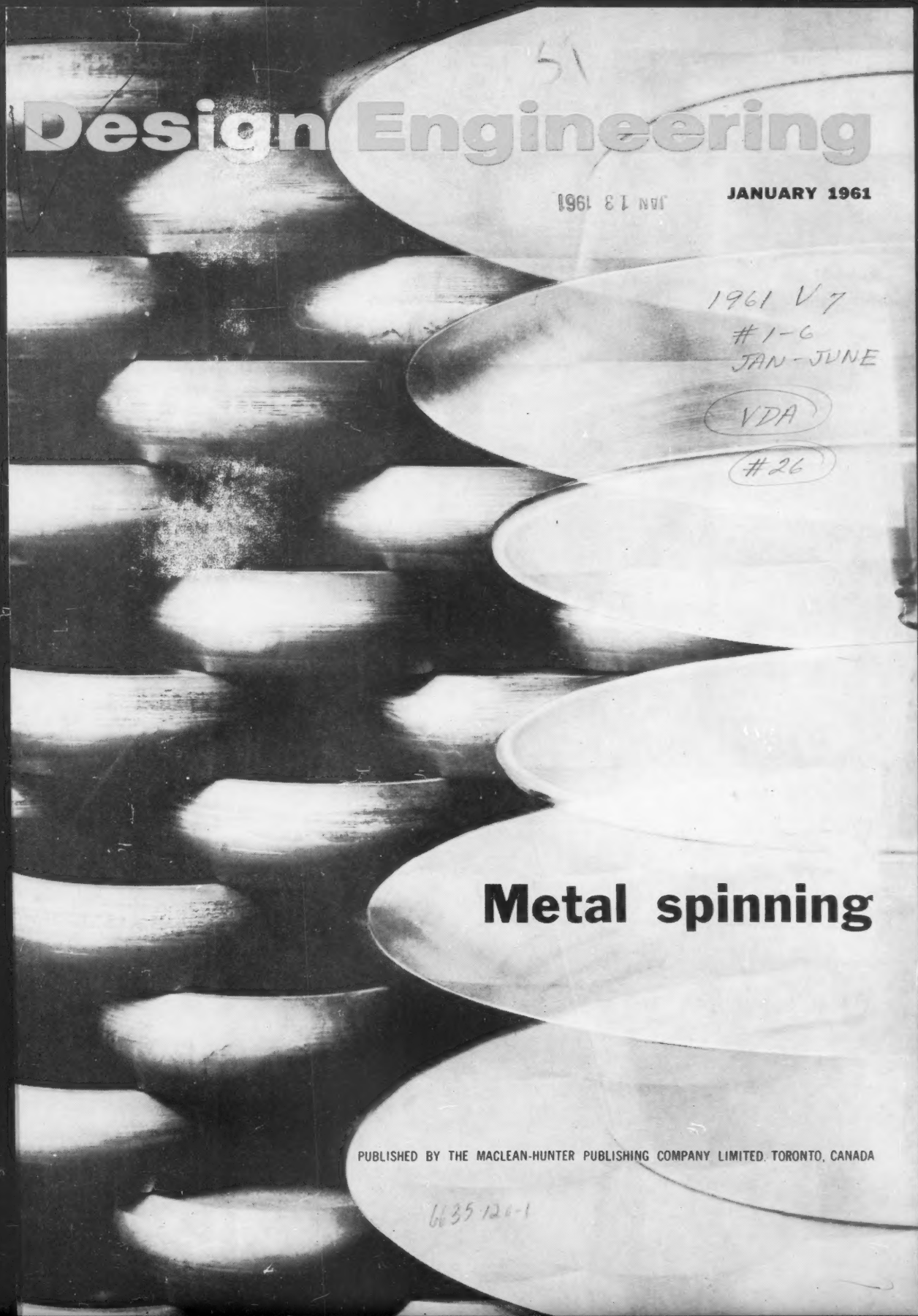

Design Engineering

JANUARY 1961

Metal spinning

PUBLISHED BY THE MACLEAN-HUNTER PUBLISHING COMPANY LIMITED, TORONTO, CANADA

Smallest of the Small. A pigmy beetle could easily crawl through the eye of an ordinary sewing needle, as shown by this equally magnified view of both. Among the tiniest of insects, some species of pigmy beetles reach about one-hundredth of an inch in length.

Miniature for Missiles. This tape recorder, shown one-sixth actual size, is a vital unit in the communications system of the Army's "talking satellite." Constant low-torque and quiet operation of MPB bearings in it maintain accurate tape position.

Man with Miracles. Like all MPB Sales Engineers, Pete Weinert helps solve miniaturization problems — by acquainting people with MPB service and facilities for engineering, research and experimental work. He's ready to do the same for you.

Miracles in Instrumentation

ACTUAL SIZE OF THE MPB BEARINGS IN TAPE RECORDER SHOWN ABOVE

Little Things That Count. There's nothing new, in the larger sense, about ball bearings. But miniaturization of these familiar components is a wholly modern development. Forty years ago, for example, MPB was first to manufacture bearings with O.D.'s as small as ⅜", and with precision that brought new aid to science and industry. Today, after continual pioneering in miniaturization, MPB produces over 500 types and sizes of bearings, ranging down to 1/10" O.D., with specials as required. Our catalog brings you details on these bearings. Write for it, or for engineering advice, to **Lyman Tube and Bearings, Ltd.**, 5420 Pare Street, Montreal. Additional offices: Toronto, London, Winnipeg, Vancouver, and New Glasgow.

MPB *Helps you perform miracles in instrumentation*

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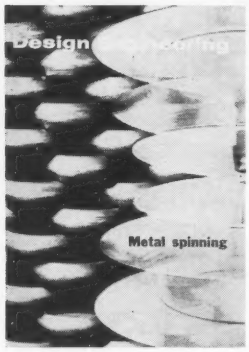

This month's cover

To help designers get a new look at some of their creations we introduce the first of a series of photographic covers. On the right is a photo-montage of four stages in the production of an angel food cake-pan, backed up by a rack of unfinished parts awaiting a final spinning operation. Credit for the photography goes to Ron Vickers, A.R.P.S.; for the metal spinnings to Toronto Metal Spinning Limited and Spun Metals Limited.

In this issue

25 Design techniques for metal spinning ..... J. F. Whittingham

It's a recommended process for limited production—say a few hundred—and for difficult shapes. Here are some valuable facts you'll want to keep on file.

28 Barrel finishing offers efficiency and low cost

Barrel finishing is a surface treatment. It solves burring problems and has many other applications as well. Cost-minded designers will relish this expert treatise.

33 Transfer mechanism systems ..... Raymond H. Dipple

An American authority writes an exclusive article for us. An excellent summary of the five basic forms of transfer mechanism.

36 Should P.Eng. Associations allow time at annual meetings for motions from the floor?

Here's another round-up of readers' views on a matter of current interest. But are readers interested in their associations? The indications are that they're not.

37 C.G.E. builds largest outdoor capacitor

A Canadian designer tackled the assignment after U. S. firms turned it down and European firms bid unrealistic prices.

38 The engineering technician—his present and his future
B. H. Goodings, P.Eng.

The author concludes his two-part survey on certified technicians and reveals that Ontario leads the world in recognizing this important group.

41 Shortcuts to maxima, minima problems ..... W. H. Sheppard, B.Sc.

The second half of a discourse on the application of partial differential to max and min problems. The author assures us it's easier than it sounds!

44 Designing for chemical welding ..... H. J. Jankowski, B.Sc.

Beginning a new three-part series. This article discusses adhesives available to the designer and their advantages. It's a necessary preface to the later ones.

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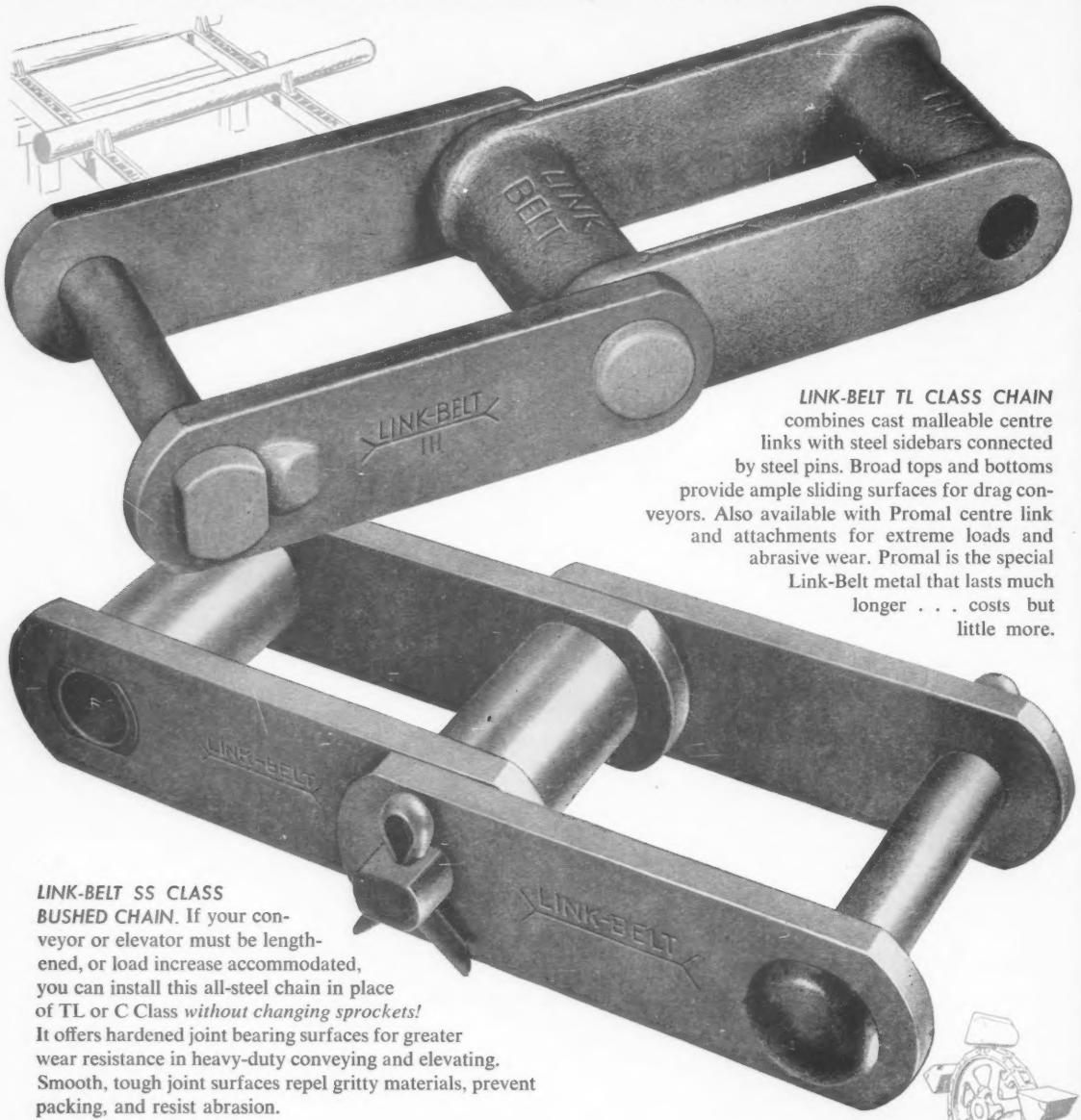
Reader Service

Before reading further, turn to the back of the book and tear out a Reader Service Card. Circle the numbers as you go and mail the completed card to us—no postage is required. We will take care of your requests immediately.

Pass your copy along so that others may enjoy this service—there are three cards.

Fewer replacements, farther between

...with these LINK-BELT conveyor and elevator chains



LINK-BELT TL CLASS CHAIN combines cast malleable centre links with steel sidebars connected by steel pins. Broad tops and bottoms provide ample sliding surfaces for drag conveyors. Also available with Promal centre link and attachments for extreme loads and abrasive wear. Promal is the special Link-Belt metal that lasts much longer . . . costs but little more.

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The staff

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The contributors

This month's contributors have many faces. This is not to say that are all a bunch of Jekyll and Hyde characters, but simply that they are passionately interested in life and the world around us and particularly the people in it. Like Alexander Pope, they believe the proper study of mankind is man.

Whittingham

Goodings

Henry Jankowski, who wrote the piece on chemical welding, is typical of this month's authors. He is active in Scouting and holds the rank of neighborhood commissioner. He is a keen chess player and from his home in London, Ont., he plays by mail with friends in California and New York. He loves fishing trips and camping.

He's now on the wrong side of forty, but there was a time when he actively participated in all kinds of sports, including football, baseball, tennis and boxing. Boxing is not something he is likely to claim as an accomplishment, however, because in his first Golden Gloves bout he lasted precisely one minute and thirty seconds.

Born in Milwaukee, Wis., he began work in 1937 with Minnesota Mining & Manufacturing and has been with the same company ever since. His first job was lab clean-up boy in Detroit, after which he did a stint in the quality control department. He was a lab technician when war broke out and it was his lot to spend the war years doing research on rubber substitutes. After the war he developed adhesive products for a time, and in 1950 he became production superintendent of the adhesives, coatings and sealers group in 3M Canada. In 1957 he was named manager, commercial development, for the group.

Because of his considerable experience in this field Henry (he's a B.Sc., by the way) has made trips to 3M laboratories in Los Angeles, Detroit, St. Paul and elsewhere. In 1956 he established adhesive production at the 3M plant in Mexico.

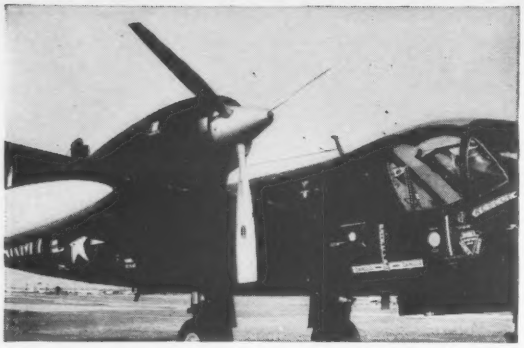
He has five children and finds it necessary to drive a nine-passenger station wagon. He frequently plays chess with his son without victory, but optimistically maintains that the boy's game is slowing down. His chief interests are trips with the children or with his Scouts.

Blake Goodings, P.Eng., field representative of the Association of Professional Engineers of Ontario, who completes his two-part survey on engineering technicians in this issue, is the association member responsible for the certification of engineering technicians. He likes to meet as many as possible of the APEO's 20,000 members to learn of their problems and hear their viewpoint.

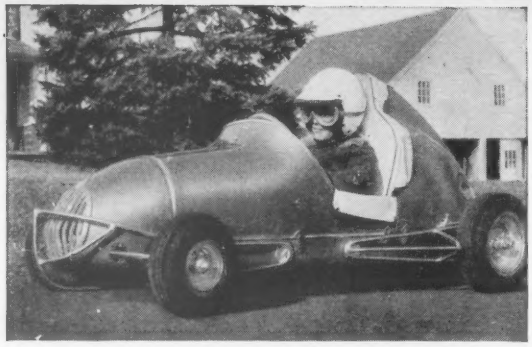
After wartime service that took him to four continents before he was 21, Blake went back to school to graduate in mechanical engineering, then returned to service in 1949 as an officer in the RCEME. While serving in Korea with the First Commonwealth Division he won a citation from the Republic of Korea for his work in the administration of a thousand Korean soldiers attached to the div. He joined APEO in 1956.

James Whittingham, who contributed the article on metal spinning, came to this country from England in 1947. In England he was first a laboratory assistant in a company developing airborne gyroscopic instruments and after the war with BOAC as an engine and airframe fitter. During the war a medical disability kept him in a civilian job as a Lockheed Aircraft flight engineer on flight tests in U. S. kites.

In Canada he joined de Havilland Aircraft Co. and spent several years in the inspection and quality control departments. At present he is freelancing as a technical writer and illustrator. He enjoys woodworking and general handicraft work and makes many models for his three children. With his family he shares a deep interest in wildlife and natural history.



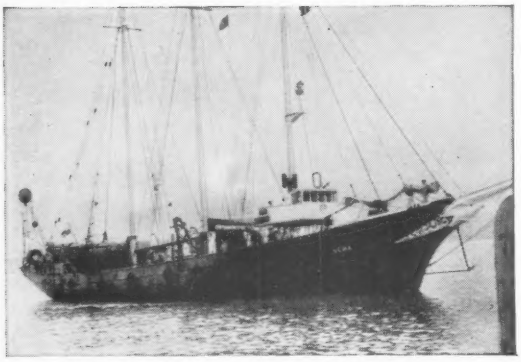
1 This propeller's epoxy-laminate spinner-de-icer was adopted to:
(a) cut wind resistance *(b) withstand temperature stress-cracking*
(c) embody heating coils



2 Tough, durable epoxy was used for this midget racer's:
(a) wheels *(b) body*
(c) paint

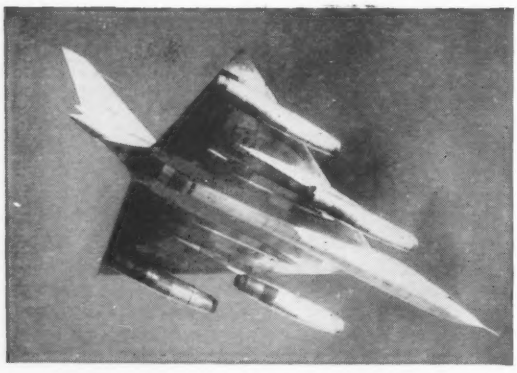
How well do you know epoxy plastics?

(The answers may suggest profit possibilities for you)



3 Her steel decks are coated with epoxy to:
(a) provide a non-skid surface *(b) reduce maintenance*
(c) withstand sun, temperature changes, and salt water

4 This motor can run immersed in water because epoxy:
(a) embeds its coils *(b) coats its housing*
(c) seals its bearings



5 The first U. S. supersonic bomber has epoxy:
(a) caulking *(b) laminated radome*
(c) embedded electrical parts

ANSWERS . . . *to tomorrow's needs are coming today from adaptable BAKELITE epoxy plastics.*

1. (b) and (c). Despite rapid temperature changes, it far outlasts metal, saving replacement cost and time.
2. (b) The laminated epoxy body is unharmed by impact that would dent metal.
3. (a), (b), and (c). Check them all. Most important – epoxy coatings protect against corrosion.
4. (a) Embeds its coils in a hard plastic block that insulates, protects against physical and chemical damage, lets motor run cooler.
5. (a) Epoxy caulking withstands surface friction and temperature changes. Others are growing aircraft uses, though.

If you have questions–about epoxy plastics and their potential for your business–please ask us. We'll be glad to answer on the uses of epoxies. Just write or call any of our offices or write Union Carbide Canada Limited, Bakelite Division, 123 Eglinton Ave. E., Toronto 12, Ontario.

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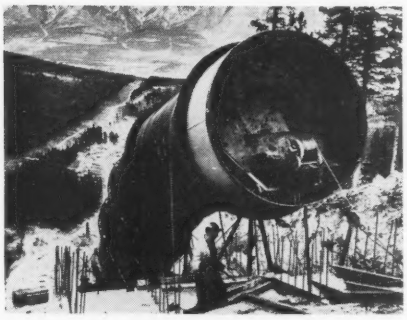
Reports — A world roundup of engineering and design interest

First T1 steel penstock in North America



One of the most challenging platework projects ever completed by Dominion Bridge engineers was the erection of a 1,600 ft. penstock for Calgary Power Ltd. The project saw the first North American application of T1 steel to penstock work; T1 was specified because of its high yield strength of 100,000 psi minimum, which permits high working stresses with an attendant reduction in weight materials, an important factor in view of the mountainous terrain. The use of T1 called for special fabricating techniques in such operations as flame cutting, rolling and fitting. Research engineers maintained strict control of all fabricating procedures throughout, including the X-raying of every inch of butt weld and the checking of fillet welds by the magna-flux method. Seen in the open end of the penstock is a self-hoisting rolling platform used to provide level footing for workmen.

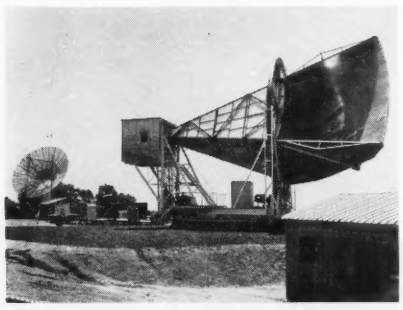
Circle 300 on Reader Service Card

They've engineered power poles out of the way

Overhead power lines are on the way out in residential areas, we hear. Advanced engineering toward this end has been conducted by the English Electric Division of John Inglis Co. Ltd. Its engineering development group has come up with a small transformer which will solve some of the problems of underground distribution systems. Surrounded by shrubs and bushes, the Minisub will look like part of the landscaping in future housing developments. Before starting work on the project, English Electric asked utilities across Canada for their views. Picture shows utilities engineers studying the unit, which will be safer for linesmen and pole-climbing boys, besides being more aesthetic all round.

Circle 301 on Reader Service Card

Outer space may solve communications problems



The first station of a satellite relay system is expected to be in space within a year. It would provide for the experimental transmission of telephone calls, television, data transmission and other types of communication between North America and Europe. American Telephone & Telegraph Co., which is financing the project, plans a system which would make use of solar-powered satellites orbiting at an altitude of 2,200 miles. Satellite communications are expected to help answer a growing demand for circuits for overseas phone calls, which now number 4,000,000 a year and are expected to be 100 million a year in 20 years. It would also provide simultaneous transmission of TV programs here and in Europe. The picture shows a Bell Telephone ground station in New Jersey.

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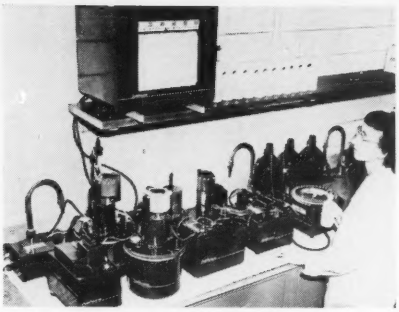
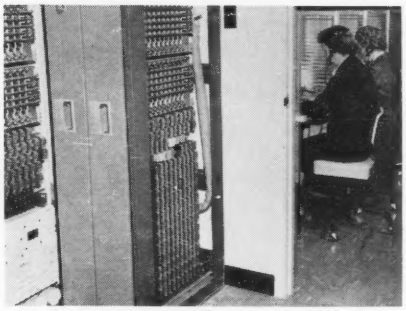
Automation note: tobacco now analyzed by a robot chemist



A robot chemist runs as many as 60 tests per hour at a new multi-million dollar Philip Morris Inc. research center at Richmond, Virginia. Known as the Technicon AutoAnalyzer, it automates each step in the chemical analyses of tobacco, such as measuring, purifying, processing, comparing and recording. The two main components of the seven module system are the sampler plate and the patented peristaltic pump. The sampler plate draws solution from consecutive samples; sample volumes may be random and need not be measured or weighed. The pump meters sample and reagent and drives them through flexible tubing to other units. Human fallibility is eliminated at every stage of an analysis.

Circle 303 on Reader Service Card

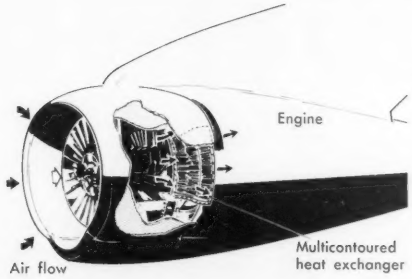
Help is coming, says a well modulated (electronic) device



It's winter, the snow is heavy on the roads and your car is stranded. You rush to the phone to call the Ontario Motor League. But scores of other motorists are doing the same thing and the calls pouring in outnumber the operators processing them. What's to do? Well, here is where the League's automatic call distributor goes to work. This electronic complex, a Bell Telephone installation and the first of its kind in Canada, distributes calls to the emergency road service operators in rotation. When all operators are busy, it stores the remaining calls, meanwhile explaining the position to callers by means of a recorded announcement. As the operators become available, stored calls are distribu'ed, again in rotation. The installation brings help to members faster than ever before.

Circle 304 on Reader Service Card

New heat exchanger eliminates ducts, cuts costs



A new design in heat exchangers eliminates the need for ducts or air scoops in airplanes or missiles, thus reducing manufacturing costs, weight and drag penalty. The new finned, surface heat exchangers actually form part of the fan exhaust air duct. Installed on opposite sides of the engine, approximately 180 degrees apart, one unit cools oil for the constant speed drive oil circuit and the other cools the turbocompressor lubrication oil circuit. The coolers are fabricated from a piece of aluminum to the general shape of the fan exhaust air duct. Oil fins and their back-up plate are brazed to one side of the plate and the air fins are milled on the reverse side.

Circle 305 on Reader Service Card

This car is one step away from immortality

To the eye there's nothing unusual about this 1960 Thunderbird, but it will last longer than the girl in the picture, or for that matter longer than anyone alive today. At least the body will. It's all-stainless steel, completely unpainted and unprotected, nor will it receive any protection during its long lifetime. The parts were made on regular production dies and from stainless steel used for ordinary automobile trim, and the Ford Motor Co. then rolled the Thunderbird from the regular assembly line at Detroit. The purpose of the special body is to display the long lasting good looks of stainless steel and its ease of fabrication and joining. The car will be displayed in auto shows across the continent and to interested persons in the automotive and allied fields.

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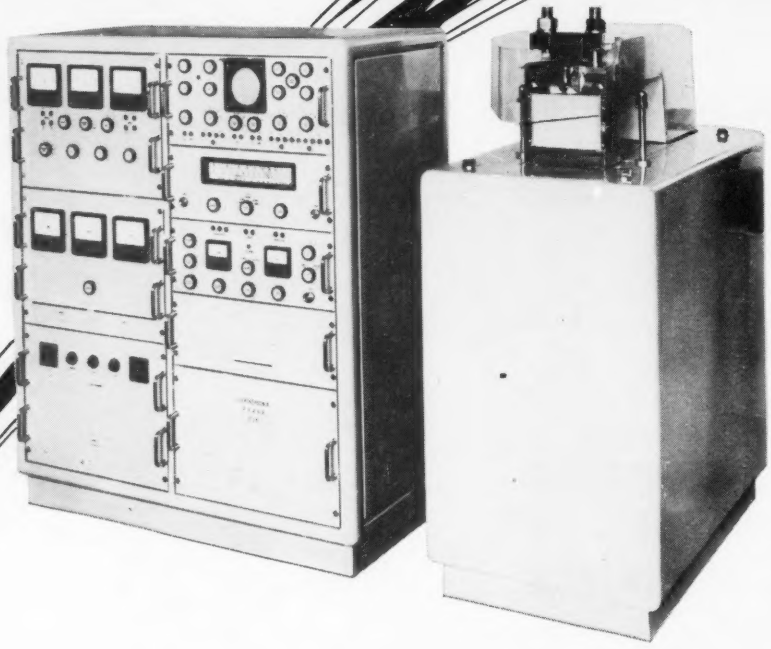
Apparatus



A self-oscillating vibration apparatus designed for fatigue testing of mechanical components and turbine blades.

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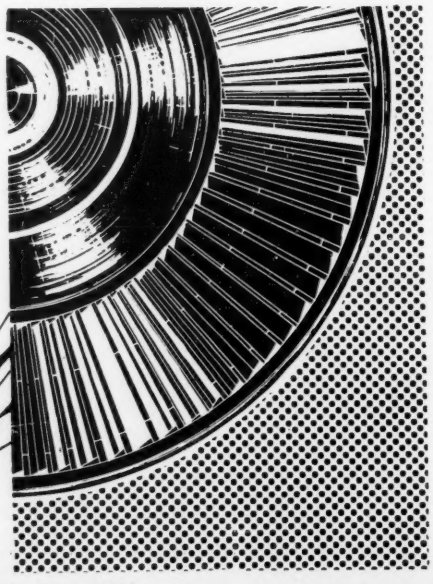

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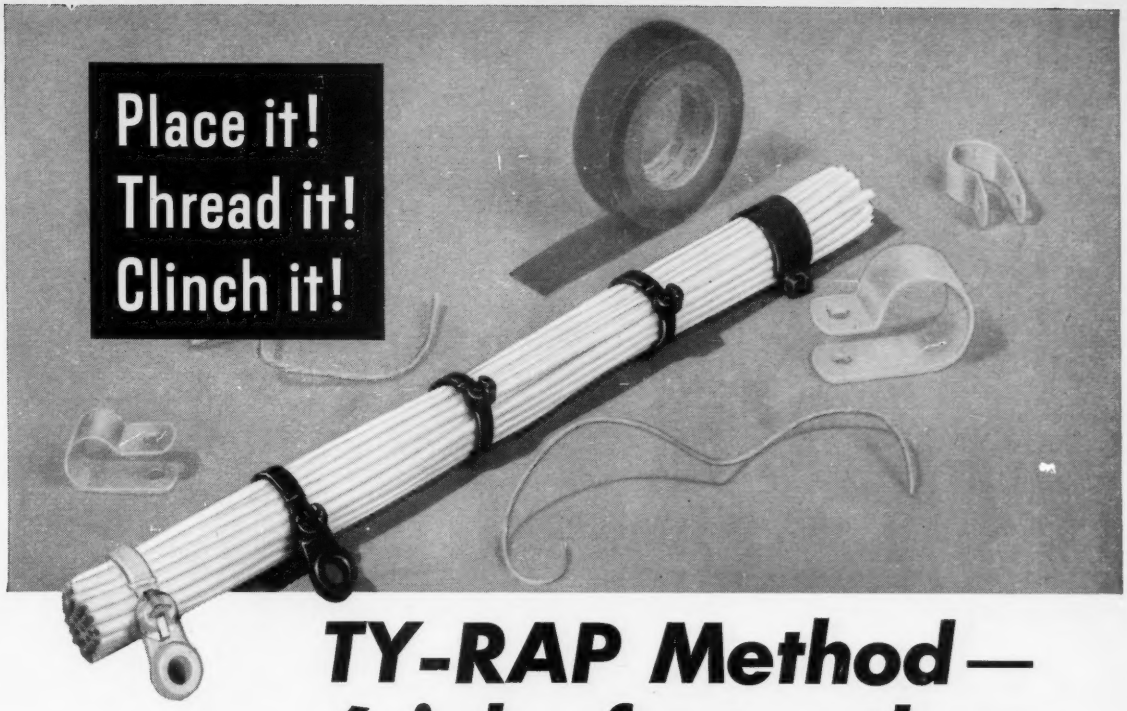

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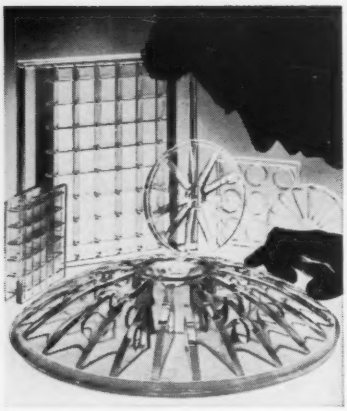
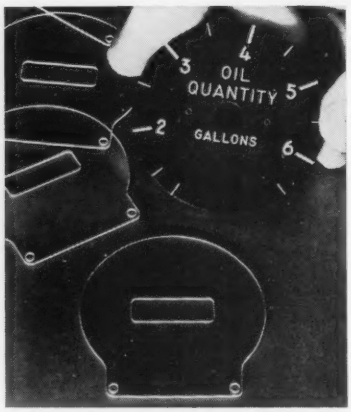
A BULLETIN OF PRACTICAL NEW IDEAS FROM CORNING





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A new fused silica which we developed is eliciting quiet approval, the most anyone expects, from the meticulous astronomer. Drop to the molecular level and you will find only several parts of impurity per million of silica.

Such purity is naturally beneficial to the optical properties of the material. It has an extremely high degree of optical homogeneity. When you talk visible or ultraviolet light, it is the most transparent glass we have ever made. On the physical side, it has a coefficient of expansion of 5.6×10^{-7}/°C. Its refractive index is n_D-1.4584. Birefringence constant: 3.40 m mu/cm/kg/cm^2. Neither gamma nor X-rays darken it.

Among some of the various products that we have made or are presently working on are telescope mirrors up to 80 inches, ultrasonic delay lines; windows for wind tunnels, high temperature viewing and star guidance systems.

We can play a few tricks with this fused silica in designing. Witness the unique sandwich construction of the mirror blanks above. This simple design innovation cuts as much as 50% off the weight of the mirror blanks without sacrificing rigidity one whit.

The coupon is your invitation to get more information on this new Corning material.

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The dial faces shown above right were made without the assistance of a single die or jig, without grinding or cutting or drilling or milling or stamping or any other mechanical operation.

We made them by exposing photosensitive glass to a precisely drawn pattern and a series of chemical etchants.

This is more than a parlor trick.

It is a method of making parts precisely which would be impossible or far too costly to make mechanically. It is the FOTOFORM® process.

We make brush holders for digital computers which call for rectangular holes measuring 0.0075″ x 0.015″.

We can take a square inch and riddle it with as many as 250,000 holes, each precisely like all its neighbors. Or, with a simple inexpensive change in art work, we could make just one of those 250,000 holes a triangle.

The material itself is nonporous and dimensionally stable glass, utterly free of flaws and voids and able to operate continuously at 500°C.

We can use the same process on FOTOCERAM,® one of our glass-ceramics which has a coefficient of expansion nudging zero.

If you would like to know more about chemical machining and the photosensitive glasses, please send the coupon.

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It's also a likely source of contamination.

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The assembly accepts a standard socket and clamp.

The glass is PYREX® brand No. 7740, so it will not serve as a source of contamination either. It's easily worked to fit into any setup, so it should be in demand for more than the usual bench-top vacuum line. There should be considerable demand among people everywhere who want a tight, greaseless joint.

The November 1959 issue of *The Review of Scientific Instruments* has something to say about this useful new tool. So do we. For our message, call your local lab supply dealer, or send us the coupon direct.

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WHY THIS IS A BETTER *LATCHING* RELAY

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Expressly designed for printed circuit applications, this DPDT, 3 amperes (@ 30V DC) latching relay lies parallel to the mounting surface. Its height, when mounted, is only .485", thus circuit boards may be stacked closer. Mounting can usually be accomplished without studs or brackets, simplifying installation.

The FL will remain firmly latched in either armature position without applied power, a significant advantage where power is limited and long relay "on" times are required. This relay may be operated by:

1. Pulsing each coil alternately (observing coil polarity), or
2. Connecting the coils in series and operating from a reversing (polarized) source.

Write for complete information or call your nearest P&B representative.

FL SERIES SPECIFICATIONS

Shock: 100 Gs for 11 milliseconds. No contact openings.

Vibration: .195", no contact openings. 10 to 55 cps. 30 Gs from 55 to 2500 cps.

Pull-In: 150 milliwatts maximum (standard) at 25° C. 80 milliwatts maximum (special) at 25° C.

Operate Time: 3 milliseconds maximum at nominal voltage at 25° C.

Transfer Time: 0.5 millisecond maximum at nominal voltage at 25° C.

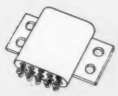
Temperature Range: −65° C to +125° C.

Terminals: Plug-in pins.

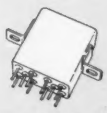
Dimensions: L 1.100" Max.—W. .925" Max H. .485" Max. Hermetically sealed only.

SC 11 D

SCG 11 DC



SL 11 DB
(Latching)



SLG 11 DA
(Latching)

Other P&B micro-miniature relays include conventional and latching models in crystal cases with a wide range of terminals and mountings. All are made in a near-surgically clean production area under the exacting requirements of our Intensified Control and Reliability program.

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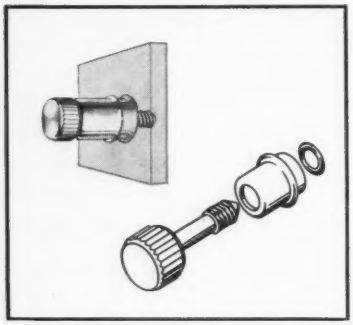
POTTER & BRUMFIELD CANADA LTD.

GUELPH. ONTARIO

Compact Captive Panel Screws:

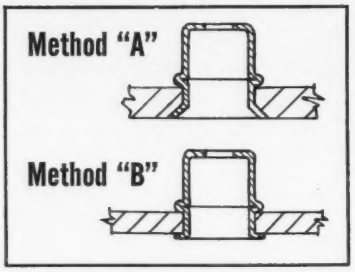
Standard Design Lowers Installed Costs

No longer is it necessary to resort to a costly fastening device of special design to provide quick attachment and release of electronic components. Standard Southco Retractable Screw Fasteners (stand-off thumb screws), available from stock, are both fast to install and economical. The five sizes,

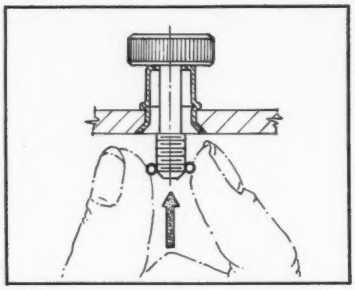


shown below, meet a very wide variety of requirements.

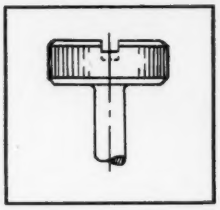
Check these advantages of simplified Southco Captive Panel Screws. Even when many screws are in one panel, misalignment is easily handled because the screw floats in a large hole in the stand-off, allowing ample play for "lining up." No special tools are



needed for installation, thus production is not subject to tool failure, nor limited by either the number of special tools available or the number of personnel trained in their use.

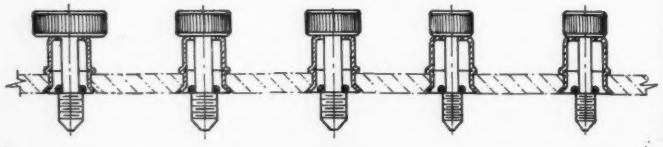


The Southco No. 58 Retractable Screw Fastener consists of three parts: thumb screw, stand-off, and retaining ring. The bright nickel-plated brass stand-off is inserted in either a drilled and countersunk hole (Method A), or a drilled hole (Method B), and flared. The polished, chrome-finished brass screw is passed through the hole in the stand-off and made captive by a retaining ring. Engaging in a tapped hole in the frame, the screw may be fully withdrawn without moving the panel, yet always is retained.



The unslotted screw is standard in $\frac{3}{4}$", $\frac{9}{16}$", and $\frac{7}{16}$" head diameters and three thread sizes. Slotted head screws are also available in all sizes. The stand-off is standard in sizes to fit panel thicknesses from a minimum of $\frac{1}{16}$" to a maximum of $\frac{17}{64}$". Screw and stand-off are also obtainable in stainless steel.

MINIATURE TO LARGE SIZE HEADS IN FIVE TYPES



HEAD DIAMETER	3/4"	9/16"	9/16"	7/16"	7/16"
THREAD SIZE	1/4-20	1/4-20	12-24	10-24	10-32

Free Fastener Handbook

Send for your complete Southco Fastener Handbook, just printed. Write to your nearest distributor listed below.

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SOUTHCO FASTENERS LION

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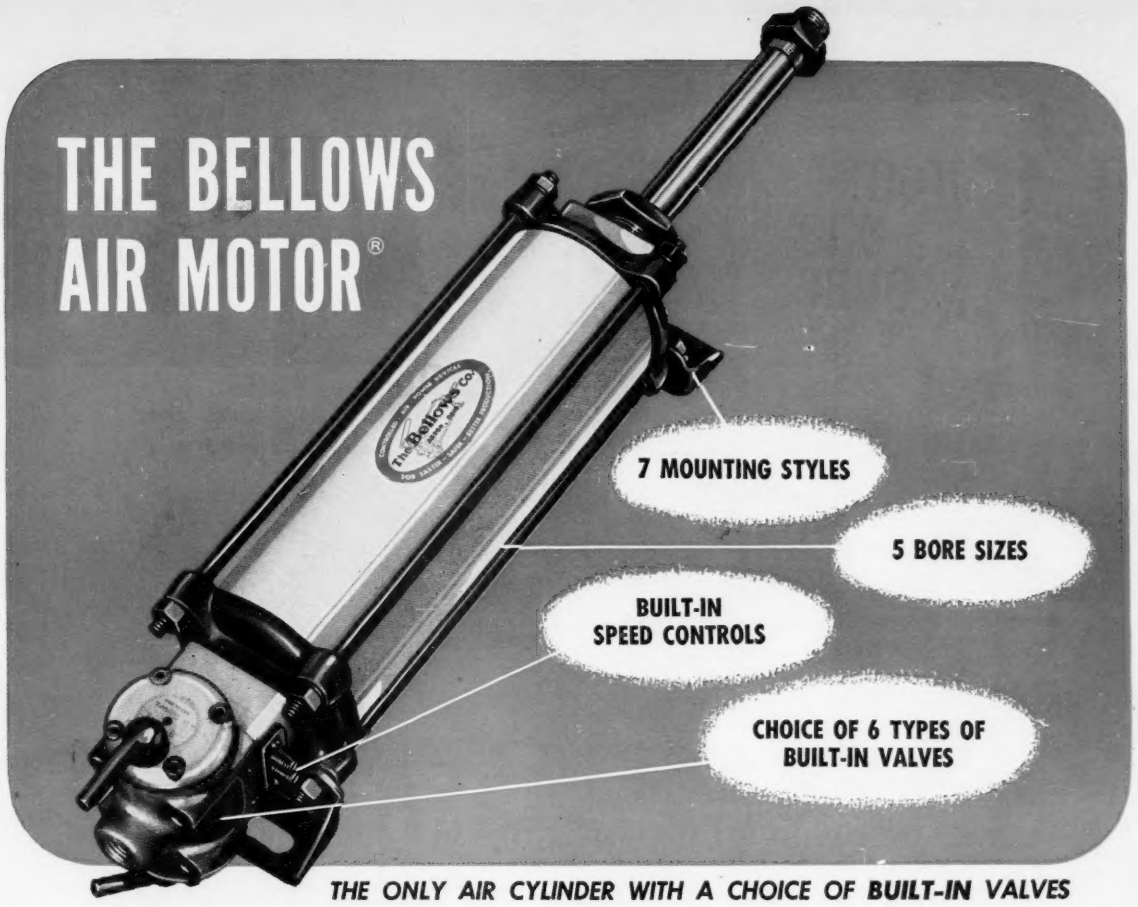
THE BELLOWS AIR MOTOR®



THE ONLY AIR CYLINDER WITH A CHOICE OF BUILT-IN VALVES

In designing for air operation, the engineer can choose the method of valving he prefers—and still have all the advantages of integral valve and cylinder construction.

Six different built-in valve arrangements give the engineer every latitude in pneumatic design.

If he prefers to use 8-12 volt electrical control with its simplified wiring, Bellows has it. If he prefers to use 115 volt control and JIC standards, Bellows has it. If he requires low or high voltage explosion-proof control, Bellows has it. Should his design require full pneumatic control, Bellows has it. Or should he wish to control his pneumatic circuits manually or through mechanical linkage or cams, Bellows has it.

Unlike conventional air cylinders which require separate remote directional and speed control valves and dual piping, the Bellows Air Motor is a complete power unit with directional valve and dual speed control valves built-in as an integral part of the unit. Only one air connection, which can be made with flexible hose, is required.

Integral valve and cylinder construction means quick response, more positive response, more precise control and more economical operation.

The Bellows Air Motor is made in five bore sizes: 1¼", 1¾", 2½", 3⅝", and 4½", and in any stroke length.

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Metals supplied by
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These photographs taken in the Winnipeg plant of Manitoba Bridge & Engineering Works Limited show four salt evaporators under construction for Dakota Salt & Chemical Company, Williston, North Dakota. Each measures 12′ 2″ in diameter x 46′ 9″ overall length and contains 1,389 tubes of Anaconda Copper 2″ O.D. x .065″ gauge x 6′ 4″.

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ANACONDA

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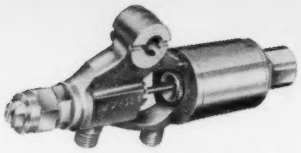
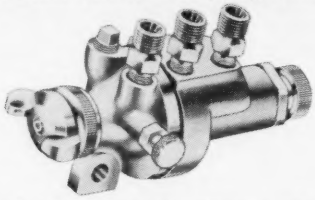
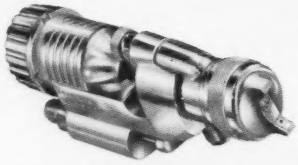


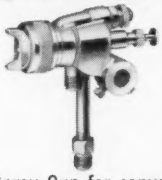
Type WV—Airless—Compact light weight, simple automatic gun for applying material suitable for Airless application.



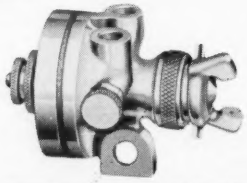
Type WDB—Specially designed automatic gun for applying lubricating oils or drawing compounds to dies, or, coolants to wheels and belts.



Type P-AGA—Built for mass production spray applications for all types of articles using automatic or semi-automatic machines.



Type P-AGA—Gang Spray Gun for conventional painting and finishing materials—in flavorings, syrups and all other non-corrosive materials.



Type WDA—is exceptionally small automatic spray gun for use in locations where conventional size guns cannot be used—oils, minerals, distillates, water, aqueous solutions, glycerine and other non-hardening materials.

An extension spray gun model for oils, compounds and non-abrasive materials.

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Design Notes on Fluid Power

RELEASE NO. 5: "SUGGESTIONS REGARDING PNEUMATIC SYSTEMS"

When you use compressed air as a means of doing work, there are three rules you should follow:

1. Keep the compressed air clean and dry.
2. Use the lowest pressure that will do the job.
3. Lubricate your air equipment.

Keeping the air clean and dry means more than just putting an air filter in the line and forgetting it. Start at the compressor: don't rely on your maintenance man to drain the air receiver every day—use an automatic drain, which doesn't **forget** or go on vacation. Install a filter just before your main air line branches off, again with an automatic drain. Remember that whenever your air cools, moisture condenses out. So use a moisture separator before each pneumatic component. Some plants still use filter-dryers with manual drains because an automatic drain costs more. Are they really saving money? The automatic drain works for nothing after they've paid for it, but their labor force costs daily.

If you need only 30 psi in a cylinder to do a job, but use 60, you are using twice the amount of power that you need. If you think you need a larger compressor, make a survey before you decide to buy; you may be wasting a good portion of your air. By installing a regulator before each component, and setting it no higher than you need, you will make efficient use of your compressor and cut your power bill. (In release #3, we reminded you that one cfm of air at 100 psi represents ¼ H.P.)

You well know the merits of lubrication. However, just having a lubricator in the line doesn't solve the problem: you must be sure it actually lubricates. Consider the difficulty of designing a unit which will give enough lubrication at low flows without flooding at high flows. Some units cannot meet this requirement. You don't have to take anyone's word: you should run tests on your air lubricators to make sure they are working as they should.

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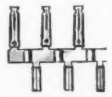

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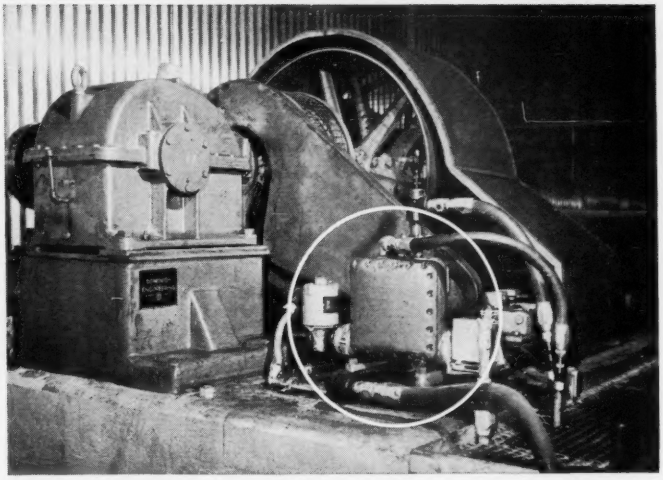
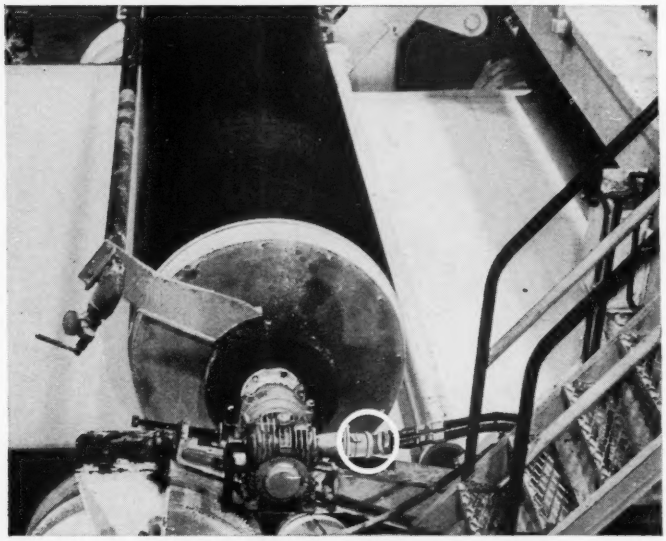
For further information mark No. 144 on Readers' Service Card

Hydraulic Drives Improve Paper Quality



Variable displacement hydraulic pump (driven from main drive shaft of couch roll drive) supplies hydraulic motor on presser roll (see below). Pump output is controlled from console. More than 500 different standard pumps are available through Vickers-Sperry.



Compact piston-type motor is easy to mount, offers ruggedness and dependability. Vickers-Sperry offers a complete range of fixed and variable displacement motors.

Matching speed of pressure and couch rolls prevents slipping, insures better quality paper. Maintenance requirements are down materially.

A design that combines rugged strength with precise control keeps the newest paper machine at Howard Smith Paper Mills, Ltd., Cornwall, Ontario, on-the-line producing an outstanding product. The machine was designed and built by Dominion Engineering Works, Ltd., Montreal, Quebec. Hydraulic drives, supplied by Vickers-Sperry of Canada, Ltd., are typical of the quality components that give the new machine performance advantages not found on earlier models.

On the presser roll drive illustrated, for example, the compact hydraulic motor drive keeps it turning at the same surface speed as the couch roll to squeeze water out of the wet stock. Because the speed of the two rolls is matched precisely, high quality paper is produced. Small speed changes, when required, are made easily by depressing a push-button at the control console.

Hydraulic drives offer other advantages, too. They are not damaged when the machine is flushed down with water or if the roll suddenly stops or is forced to slow down. Maintenance requirements are down sharply over installations using chain or belt drives. Because hydraulic drives offer constant torque, they are ideal for this roll application.

Application engineers at Vickers-Sperry offer Canadian machinery builders and users a broad base of experience in hydraulic drives and controls. In addition, they can select from the most extensive line of hydraulic equipment available anywhere to insure performance matched to your installation needs. Refer your problem to the Vickers-Sperry office nearest you. Write for Catalog 5001C.

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Ask your Gates Representative to show how Super HC Drives save space, weight, money

If the sheaves and V-belts of a machine need replacing or if a chain, gear or other type of drive isn't giving you good performance, your local Gates Representative will be glad to help you. He can show you how to take full advantage of the many opportunities offered by Gates Super HC High Capacity Drives.

Ask him to design a drive for your machine two ways: A conventional V-belt drive and a new Gates Super HC High Capacity V-Belt Drive. A quick comparison will show you many of the important savings provided by the new Gates drive.

Industrial plants throughout Canada have standardized upon the Gates Super HC V-Belt Drive—industry's first and most advanced high capacity drive. It is your best assurance that your power transmission unit will not soon become obsolete.

Your local Gates Representative is an experienced, fully-qualified drive design expert. Contact him for drive design help.

Gates Rubber of Canada Ltd., Brantford, Ontario

X955E

Gates Super HC Drives give you these benefits:

Handles up to 3 times more hp than conventional V-belts in same space.

Saves up to 50% in drive space and reduces drive weight 20% and more.

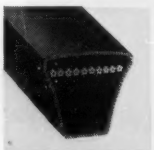
Cuts drive costs as much as 20%.

Reduces bearing load, increasing bearing life.

Guards can be smaller, lighter weight.

Belt speed up to 6000 ft/min possible without dynamic balancing.

Less costly, higher speed motors can often be used.



Exclusive design features include: precisely engineered arched top, concave sidewalls, Flex-Weave cover, super strength tensile construction.

Gates Super HC V-Belt Drives

World's largest maker of V-Belts

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...to meet assembly line specifications!

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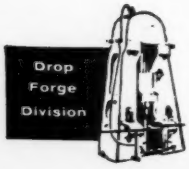
Stelco is equipped to turn out a wide range of highly uniform forged parts to meet quality specifications. For additional information or engineering advice, contact Stelco at Gananoque or at any Stelco Sales Office.

Please quote reference No. 160 when enquiring



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Design techniques for metal spinning

"Shapes can be successfully spun that would be difficult or impossible to fabricate by other means," says author J. F. WHITTINGHAM.

The utilization of relatively inexpensive tooling features the spinning process for forming metal into spherical or related shapes as one of the most economical methods of manufacture for limited production.

For requirements in excess of one thousand parts, the alternative and faster method of die stamping is preferable. At this quantity the initial tooling expenditure has been absorbed and the lower associated labor costs become effective for the continued output.

Figure 1 graphically illustrates the foregoing. Although compiled from an actual job cost analysis the curve characteristics are representative of this method of manufacture.

The spinning process, while basically limited to symmetrical shapes of circular cross section, is applied to the manufacture of a variety of articles, from small fittings to large components for domestic, industrial and commercial usage.

Shapes can be successfully spun that would be extremely difficult, prohibitively expensive or impossible to fabricate by other means, for example, hollow seamless parts with necks or openings smaller than the main body diameters.

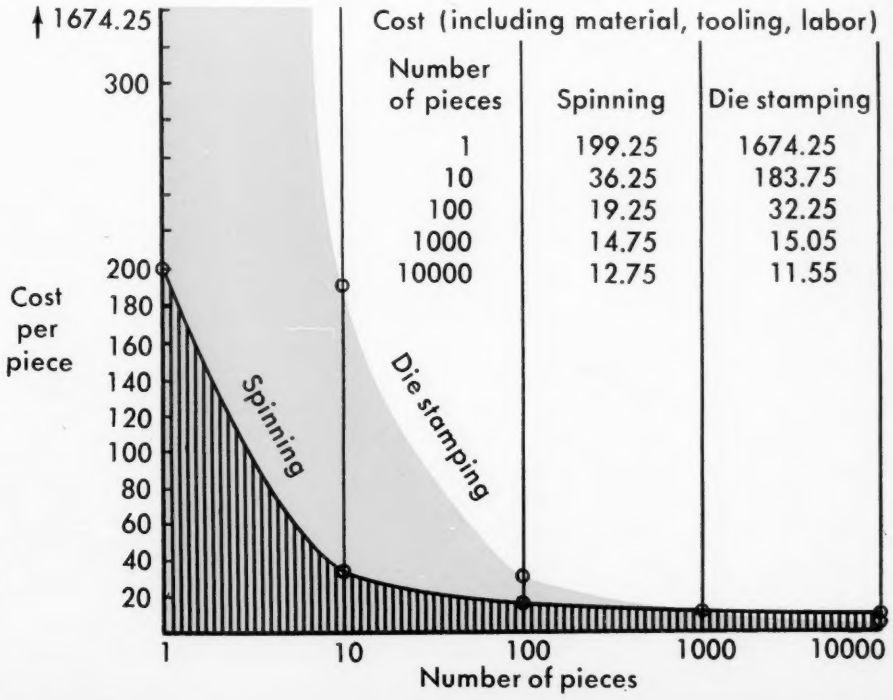


Fig. 1—Comparison of costs for spinning and die stamping processes.

continued ▶

Spinning tools and equipment

A regular spinning lathe, (or lathe modified for the purpose), shaped forms, hand tools and annealing factilities are required for the spinning process.

The hand forming tool is a bar with a shaped metal bit through which pressure is applied to the work with lever action across a fulcrum pin located on the lathe fixture. Although the bits are made or selected to suit the specific job requirement, the basic tool is flat and spoon shaped with rounded nose and corners. One side is used for pressing the metal to the required shape and the other for smoothing the spun part. To prevent scratching the sheet metal the bits are highly polished on all contact surfaces. Additional hand equipment consists of the cutting tool for trimming sharp or excess metal from the lip of the spun part, the point tool for forming curves of small radii, the concave beading tool for beading or curling edges, and the planishing tool for the final polishing.

The forms, or chucks, upon which the metal is spun, are normally made of hardwood or plastic, but for forming large quantities of close toleranced parts, or heavy gauge metal, partial or complete steel chucks are used.

The small wooden chucks are made in one piece and the large ones in laminated sections.

Chucks cut into wedge shaped pieces are used to form parts designed with an opening smaller than the main body diameter. The metal is spun over the assembled collapsible chuck. At the end of the spinning operation, the chuck is dismantled and removed in sections through the body opening.

Breakdown chucks are used when combinations of size and material make it necessary to process the metal to the required form in stages. The metal is spun completely down on each chuck of a series, each one of which gradually approaches the final required form.

The spinning procedure

A disc of rolled sheet metal is centred in a spinning lathe and while rotating, pressed into the required shape on a chuck by a spinning tool. Soft metals are normally formed in one operation while hard metals may require several annealings before the final form is reached.

The sheet metal disc, called the blank, (Figure 2, part A) is clamped to the chuck B by a friction block C that freely turns in the tail centre D. The blank is lubricated with soap, oil or tallow and rotated. Pressure is applied over the area of the blank by the spinning tool E supported on the spinning rest F and levered against the fulcrum pin G. The fulcrum pin is located near the blank and the nose of the spinning tool placed just below the axis of rotation. Side

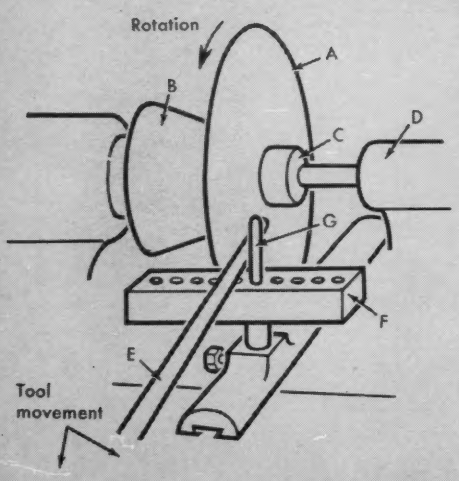


Fig. 2—Arrangement of blank and lathe parts for manual spinning operations.

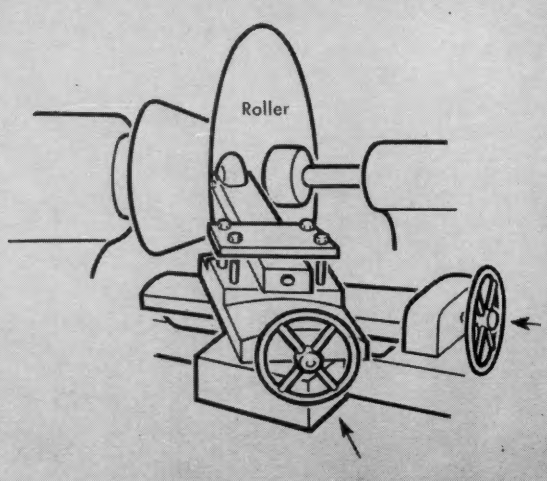


Fig. 3—Arrangement using roller type spinning tool mounted on lathe for spinning large parts.

pressure is applied against the fulcrum as the spinning tool is drawn backwards, "spreading" the blank over the chuck. As the blank shape progresses it may be necesary to relocate the fulcrum in the rest block to provide the leverage required. The blank, when spun practically to its required shape, is trimmed with a cutting tool and then finish spun to fit the chuck. To prevent intermediate bulging or wrinkling during the operation care must be taken to spin the metal firmly on the chuck before pressure is applied to the outer edge.

When spinning large parts of hard metals greater pressures are required on the spinning tool than can be applied by the previously described method of hand forming. Figure 3 shows the arrangement for transmitting considerable pressure to the blank through a roller type spinning tool mounted on the lathe, facing cross saddle. As with the hand forming procedure the blank is worked slowly and gradually to the shape of the chuck, trimmed, and finally spun down to the required form.

Special design requirements

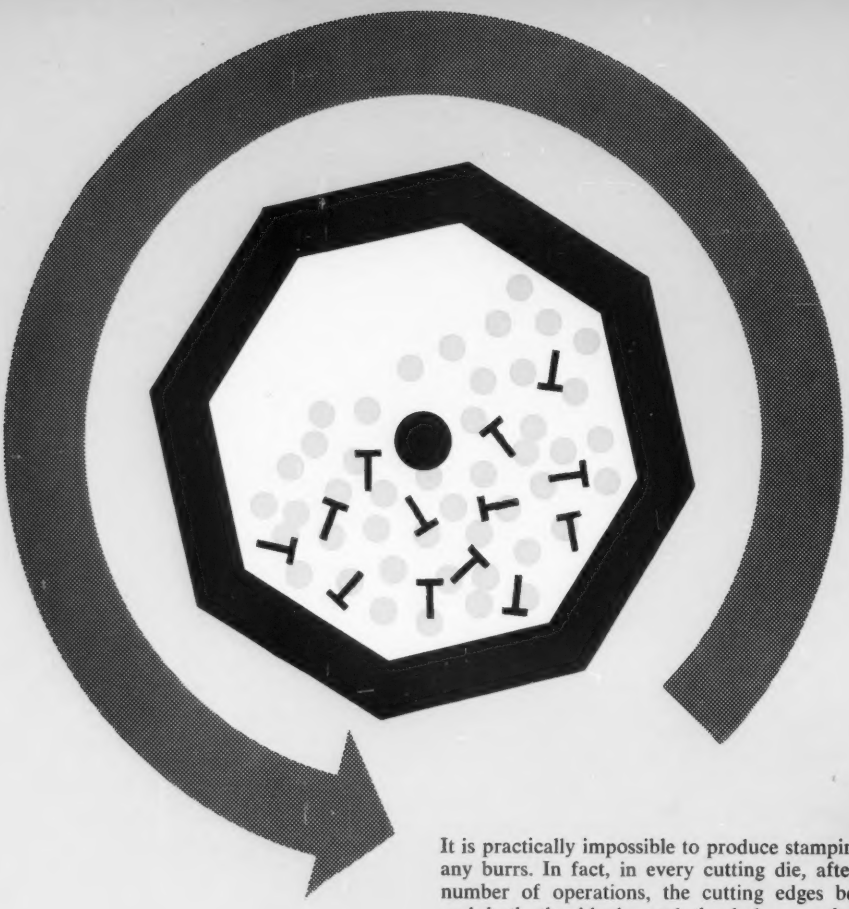
Spinning operations on tubular shaped objects are generally initiated from the already welded cylinder or cone. The tube or cone is slipped over a chuck and spun lengthwise. Assemblies embodying inside flanges or re-entrant parts are spun in sections and assembled by welding or riveting. Tubes can be closed and sealed completely at one end, tapered by spinning the metal down over a form, flanged or bell ended by clamping in a hollow chuck and spinning the end of the tube back against a shaped block.

Although spinning is mainly a hand operation, the finished parts of a series are uniform in size and appearance, and close dimensional control is practiced. The "Normal Tolerances" detailed in the accompanying table are the limits to which parts are produced. Closer limits are attainable, as listed in the "Special Requirement" column. Articles designed to be manufactured by the spinning process must have adequate allowance made for the loss of material thickness in the vicinity of sharp bend radii, especially if the parts are to be stressed or pressurized in service. Metal thickness however can be held to within ± .010 inch of the specified thickness for gauges up to and including .040 inch and to within ± .015 inch for gauges over .040 inch.

Although nearly every type of rolled sheet metal can be spun in the cold condition, the less malleable materials require annealing prior to, or during the spinning operation. Table below details the spinning characteristics of the most commonly spun metals and the heat treatments required. ★

Metal	Ease of spinning	Remarks
Aluminum Alloys		
2 SO	Very easy	No annealing
3 SO	"	Intermediate annealing for deep spinning
24 SO	Difficult	"
52 SO	Easy	"
61 SO	Average	"
Copper Alloys		
Copper, annealed	Easy	Little annealing
Yellow brass, annealed	Easy	"
Comm. bronze, "	Average	"
Cupro-Nickel	Easy	"
Nickel silver	Easy	"
Low Alloy Steels		
S.A.E. 1010, 1015, 1020	Easy	No annealing
Armco iron	Easy	"
Std. cold rolled	Easy	Little annealing
High tensile steel	Very difficult	Annealing required
Stainless Steels		
302, 304, 310	Average	Annealing required
316, 312, 347	"	"
410, 430	Difficult	"
Nickel Alloys		
Monel	Easy	Annealing required
Inconel	Average	"
Stellite A	"	Annealing required
Stellite B	Difficult	"
Hastelloy	Very difficult	"
Miscellaneous		
Tantalum	Average	Annealing required
Magnesium	Difficult	Spun hot
Molybdenum	Very difficult	"
Titanium	"	Spun hot

Tolerance	
Diameter over 4 ft	
normal	± ⅛"
special requirements	± 0.030"
Diameter 1 ft to 4 ft	
normal	± 1/32"
special requirements	± 0.020"
Diameter less than 1 ft	
normal	± 1/64"
special requirements	± 0.010"



Barrel finishing offers efficiency and low cost

Barrel finishing is a surface treatment in which a mixture of parts, abrasive media and various compounds is rotated in a container. Deburring, grinding, cleaning and burnishing are readily achieved. Proper design is the key to the whole operation.

It is practically impossible to produce stampings without any burrs. In fact, in every cutting die, after a certain number of operations, the cutting edges become dull and both the blanks and the holes punched in them begin to show burrs, even if the first ones were absolutely burr-free.

The maximum allowed burr-height depends on various circumstances, such as the ultimate utilization and function of the components, the kind and number of forming and drawing operations to which they will be subsequently subjected and finally, what can be easily eliminated afterward by the usual burr-removal methods.

While in short-run jobs the elimination of burrs and sharp edges is done individually by filing, scraping. grinding, sanding, wire brushing and ultrasonics, in the case of regular production of stampings in large volumes, it is much more economical to do it by tumbling. This operation is now done on a large number of workpieces simultaneously and automatically. One man can operate a battery of barrel finishing units, thus avoiding the necessity for several skilled workers. Consequently tumbling is a very low cost process.

The chief goal of tumbling consists of the elimination of burrs, toolmarks and the rounding of sharp corners and rough edges. However, there are a number of additional advantages which are obtained:

a) Improvement of surface finish, by removing scale and excess metal.

b) Decrease of accidents to the workers' fingers during later assembly and handling of the stampings.

c) Ensuring better assembling conditions — better mating of male and female parts.

d) Increase in strength, thus eliminating cracking of the stampings during subsequent forming operations or during critical stresses under load.

Tumbling is not a new process; it has been known for over 100 years. However, up to a few years ago, it was considered as a rough, inaccurate metal-working method. The more-or-less random action of the process was slow, expensive and often gave unsatisfactory results. Burrs were not always removed but only peened over, consequently, surface imperfections were not eliminated completely. However, with the development of correct, scientifically controlled, thoroughly tested media (chiefly abrasives and chemical cleaner compounds) barrel finishing has become a precision metal working process.

The working principle of tumbling consists of letting the workpiece rotate for a certain period of time in a suitable container (barrel, drum, chest) together with additives (water, abrasives and cleaning substances). This causes a continuous rubbing of the pieces. In this way, by the controlled abrasive action of the chip mass, burrs and toolmarks are cut away, sharp corners are rounded and an over-all better finish is obtained.

The chief influencing factors which determine the requirements in barrel-finishing are:

- the shape and size of the workpieces
- the characteristics of the metal from which they are stamped
- the size of the burrs to be eliminated, and their location
- the kind of finish needed
- the quantities to be processed

These requirements are met by the correct selection of following variable operational details:

- type, size and quantity of the abrasive
- operating speed
- equipment (chiefly the size, shape and number of barrels, and kind of lining)
- duration of the operation
- amount and kind of cleaning compound and other additives.
- ratio of the tumbling mass (work, abrasive, cleaning compound with respect to the barrel capacity)

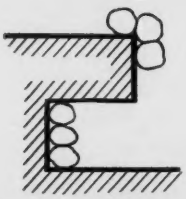


Fig. 1—Large size grains give efficient removal on external edges, but are inefficient in recesses.

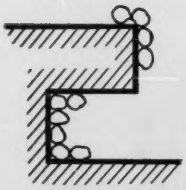


Fig. 2—Finer grain abrasive works better in the recesses and gives more accurate surface finish.

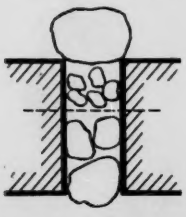


Fig. 3.—Size of grain must be small enough to pass through holes.

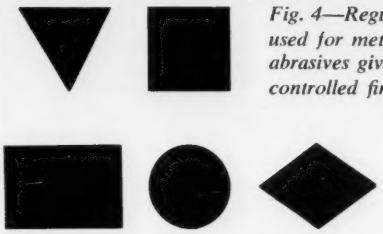


Fig. 4—Regular shapes used for metallic abrasives give easily controlled finishes.

Selecting the abrasive

If the sole purpose of the tumbling operation is eliminating small burrs and rounding the sharp edges, then the stampings are sometimes processed without abrasives and only with cleaning compounds (if wet) or with sawdust (if dry). This is often referred to as the self-tumbling process.

However, if the burrs are of considerable height and/or, in addition, the surface finish of the stampings must be improved, then it is necessary to employ some kind of abrasive.

The abrasive has two functions: first, it helps in the actual elimination of the burrs and surface irregularities and second, it serves as some kind of cushion which separates the workpieces by filling out completely the space between the workpieces and thus avoids the danger of bending or deforming the components.

The selection of the abrasive must be very carefully done, taking into account the following criteria: a) size and shape of the stampings, b) kind of metal from which they are made, c) conditions of the stampings and d) kind of surface finish desired.

The more and the larger the edges to be processed, the more intensive must be the abrasive action. The hardness of the abrasive must be in direct relation to the hardness of the metal to be processed. Ordinarily, in case of harder materials, the deburring process is more efficient. When the burrs are too large (more than 0.020 in height) it is necessary to remove them by other methods than tumbling. In case of too fine surface finish requirements, it will be advisable to make two tumbling operations: one of deburring with coarser finish and then a finishing operation for getting the desired grade of surface.

There are three kinds of media commonly employed in barrel finishing operations, namely natural, synthetic and metallic.

The natural abrasives are mineral chips whose hardness ranges from granite (pebbles or chips) to pumice. Obviously the harder ones are used for harder metals and vice versa.

The natural abrasives do not give very satisfactory performance, because they are irregular in shape and they either break down too slowly and do not present the constantly rough surface which is needed for cutting or abrading, or they break up into small pieces and these then fill up the holes and slots of the processed components. At any rate, they are cheap and work well if employed together with abrasive compounds. It is good practice to tumble the natural chips, before grading them to size.

The synthetic media are manufactured abrasives which eliminate the drawbacks of the natural media. In fact, as the chips wear they continually generate new sharp cutting edges and thus their efficiency is maintained through their whole life. They are more uniform

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in shape and size and they have no tendency of chipping or breaking up into small pieces. They are chemically inert, so acids and detergents do not affect them. Against these advantages, the only drawback consists of their higher cost.

Metallic chips, in shape of balls, stars, slugs, diagonals, nail fins, pins and cones, are often employed where greater surface uniformity has to be obtained and where the work has recesses and corners to be finished.

The steel chips may be used either soft or hardened. It seems however, that the soft steel gives better cutting performance. Of course, metallic chips can be employed only in combination with some kind of abrasive in fine grains. These become embedded in the steel chips and effect the cutting action, thus the preference for softer chips. With proper selection of the right compound practically every metal may be processed with steel chips, from soft aluminum to hardened steel stampings.

Avoid chip sizes which approach the size of the workpieces, because the separation by screening, which is the most popular method, after the tumbing process becomes impossible.

The hardness of the constituting metal must be taken into consideration. Harder metals require larger chips, because they are heavier and therefore have more intensive cutting action, while softer metals need smaller chips.

In case of manufactured chips, their shape should also be taken into consideration for achieving best results. The chief chip shapes are: triangular, square, rectangular, round and diamond. The efficiency of a given size of abrasive grain varies with the shape and position of the surfaces to be processed.

1.—Maximum abrading efficiency is obtained, logically, on sharp edges and corners, i.e., on the most exposed portions of the stamping, or on the burr side edge of the blank (fig. 5 top left).
2.—Even a slight rounding of the edges reduces the efficiency to about 70%, e.g., on the opposite edge of the blank (fig. 5 top centre).
3.—A greater rounding radius reduces efficiency to about 60%, e.g., the outer contour of a bent stamping (fig. 5 top right).
4.—In case of flat vertical surfaces the efficiency is about 50% (fig. 5 bottom left).
5.—Concave vertical surfaces have a very low efficiency; only 20-25% of that of sharp edges (fig. 5 bottom centre).
6.—Vertically located undercuts, deep recesses, unexposed areas cannot be processed because the abrasive is not able to reach them (fig. 5 bottom right).

Cleaning compound additives

The tumbling process is seldom done dry as it works better wet. So, to the mixture of work and abrasives, water is usually added in sufficient quantity to provide some lubricating effect, to keep the parts apart and to avoid loading of the abrasives (coating them with metallic particles).

In addition, some cleaning compound is often added. This has several goals. It removes oils and greases which remain on the stampings from the previous press-working operations. On the other hand, the cleaning compound sometimes furnishes a certain lubricating action of its own which is necessary for the smooth sliding of the parts.

The cleaning compound prevents the glazing of the abrasive media by means of the fine metallic particles

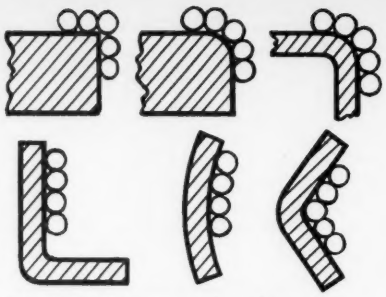

Fig. 5—Efficiency of barrel tumbling operations varies with the piece being worked.

Fig. 6—Barrel finishing is less effective as shapes move from plain to more complicated (left to right).

Typical applications for barrel finishing

Cost-minded designers find many applications for this technique, including:

DEBURRING — Parts made by automatic machining or stamping. Hundreds of examples can be seen every day.

ROUGHING — Provides a controlled surface texture or roughness. Used also as a first or rough grinding operation. Applied on heavy parts such as castings or parts requiring a large radius.

DESCALING — More suitable for small parts than pressure blasting or hand cleaning methods. Ideal for machine parts, hand tools, hardware.

BURNISHING — The optimum in metal finishing. Hardware, cutlery and other household articles are prime examples.

separated from the stampings by the deburring process. Such particles should remain floating in the solution.

As stated above, the wet tumbling process is preferred because it gives a superior cutting action. However, much depends on the quantity of liquid. This should be as low as possible, compatible with the correct cleaning and abrading action required. If too much liquid is used, then the media will sink to the bottom of the barrel; if too little liquid is used, the abrasive will cling to the stamping and the drum. In both cases the results will be far from satisfactory.

Equipment required

Tumbling is effected in barrels which are rotated slowly at a constant speed. There are several types of barrels. The majority consists of drums which rotate around a horizontal or an inclined axis. In the first case the barrel must be, obviously, completely closed while in the second case, they may be open.

Open, tilted barrels offer the advantage of being easily loaded and unloaded. The progression of the tumbling process may be inspected without interrupting the barrel rotation and the axis inclination may be arranged to give any desired results within the range of the machine. The closer the axis of rotation approaches the horizontal, the more intensive becomes the tumbing action.

However, the most usual, the most preferred, the most largely used type of barrel (especially for burr-removal) is the closed horizontal one with octagonal cross-sectional shape. The octagonal barrel is the most efficient because it takes the work higher up before it slides down.

Commonly, barrels have one compartment, but for certain special applications there may be two or several separate compartments. The interior of a barrel may be smooth or corrugated, sometimes even provided with steps or lifters; in these latter cases the lifting action is more pronounced, consequently slower speeds (rpm) may be adopted.

Barrel sizes vary among rather large limits. The most economical size depends upon the size and quantity of workpieces to be processed. Maximum size seems to be about 30 to 32 inch diameter.

For best results, the mixture of work, abrasive and additives should move not only circularly, but also longitudinally (in a direction parallel to the axis of the barrel) slowly reciprocating, in order to get a more intimate relative movement and consequently a more efficient tumbling action.

Multiple driving of barrels may be made according to any standard method. However, sometimes, it is preferred to do it in some original unconventional way. For instance, in one case (fig. 7) a large steel disc is used with the barrels mounted either concentrically or peripherally (with axis parallel or inclined to the main axis) thus obtaining different speeds and different tumbling efficiencies.

In another case (fig. 8) the barrels are friction driven on rollers which are — in their turn — rotated constantly. In this case the peripheral speed depends upon the drum size.

Operating speeds

The determination of the right speed for the barrel is done empirically, by practical trials. If the speed is

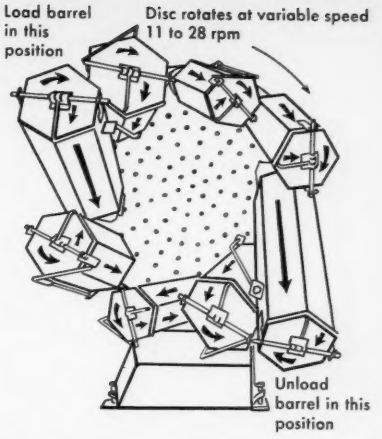

Fig. 7—Barrel mounted in different positions on large steel disc provides different speeds and efficiencies.

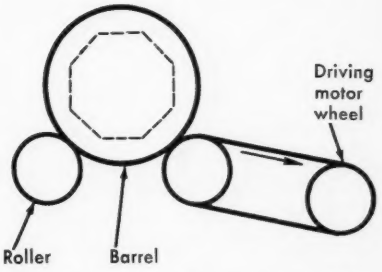

Fig. 8—One simple arrangement has barrel friction driven on rollers which are rotated constantly.

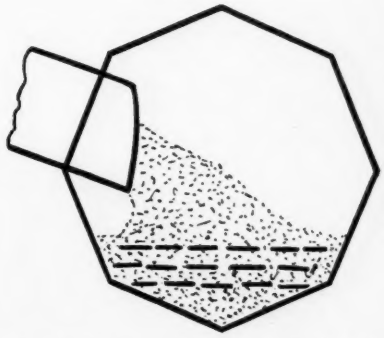

Fig. 9—Parts and media are loaded alternately in layers for most efficient operation.

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Fig. 10—When speed is too low, mass does not slide enough.

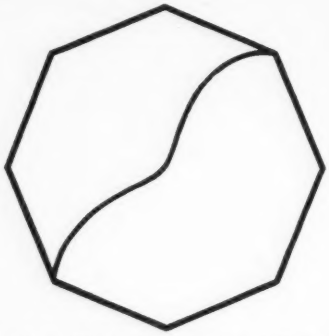

Fig. 11—High speeds cause falling instead of sliding.

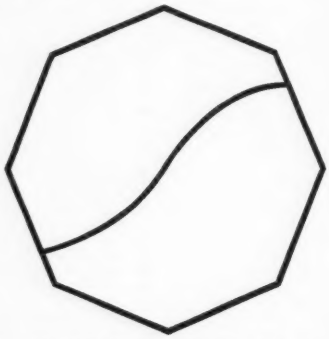

Fig. 12—Ideal arrangement has charge sliding at 45 degrees.

Fig. 13—Smooth rolling movement gives compact sliding mass.

too low (fig. 10) then there is too little rubbing action because of too little relative sliding of the mass. The same happens also with too high speeds (fig. 11) where the materials fall down instead of sliding one upon the other. Practice teaches that the correct speed corresponds to a value where the charge is disposed according to a sliding line of about 45 degrees (fig. 12). This gives a smooth rolling movement because the parts turn over and move slowly in a compact, sliding mass.

In general, slower speeds are more effective than fast ones; the usual range is between 15 and 25 rpm for a 30-inch barrel, or 10 to 20 rpm for a 32-inch barrel.

The duration of the deburring operation by tumbling varies between very large limits, from 10 minutes to 12 hours or more.

Secondary factors of operation

It is reported that better results are obtained if the barrel rotation is reversed periodically every 30 to 45 minutes.

During the tumbling process hydrogen gas is produced, because of chemical reactions. In certain cases this gas may be expanded by frictional heat to such an extent that the pressure produces explosion of the barrel. In order to prevent this, suitable safety vents, automatic or manual, must be provided.

Since heat and consequent evaporation reduce the water content during the tumbling operation, if its duration is too long, it is recommended to add water at regular intervals.

If the parts are tumbled for the first time, it is advisable to stop the barrel every 15-20 minutes and inspect the progress of the operation. If necessary, take corrective measures.

It is good practice to degrease the workpieces before the beginning of the operation, if they have been produced with much lubricant.

Avoid mixing workpieces of different shapes or sizes of metal, because it is very difficult to obtain uniform results in this way.

Hardened stampings are easier deburred than soft ones. So, in case of steel components, they may be hardened, quickly tumbled and then annealed or tempered as needed.

Suggestions for the design of components

The designer of stampings should take into account the following details for those stampings which must be submitted to some deburring by the tumbling process.

The components must have simple shape (to avoid the danger of becoming entangled with one another), free from sharp edges and sharp angles, too large flat surfaces and areas with recesses. They should be designed so that the chips and the tumbling compound can reach uniformity at each point of the stamping. Design for uniform weight-distribution avoiding too heavy sections together with too light sections in the same workpiece.

Generally, small parts are better suited for tumbling than large ones. Maximum practical size seems to be about 6 inches. Parts must have sufficient strength in order not to be bent or deformed by the tumbling. ★

The era of automation in machine operations has called for the optimum in design concepts. Read what RAYMOND H. DIPPLE has to say about the five basic . . .

Transfer mechanism systems

The majority of experience in transfer machining has been gained from the automobile industries. This considerable knowledge is now available as proven design principles to any industry capable of exploiting the ideas and adapting the designs to suit individual problems.

From experience already gained, several distinct methods of transfer have been evolved, each capable of being operated by mechanical, electrical, pneumatic or hydraulic systems to suit individual service requirements.

Basic methods of transfer

Prior to the acceptance of transfer machines, work was traditionally passed over roller conveyor from one machine to the next. This method persisted for a considerable period despite the fact that some successful transfer machines appeared around 1923. These machines unfortunately suffered the demise too often associated with pioneer ventures.

The versatility and reliability of modern control equipment have acted as a great stimulus in the successful development of transfer machines and helped stabilize design.

There are now five basic forms of transfer mechanism in common use.

1. Ratchet type.

The incorporation of a series of spring loaded pawls, at intervals on the length of a transfer bar, appeals for its simplicity and low capital cost.

A transfer bar, either complete or in sections for ease of alignment, runs the length of the machine, the pawls being spaced at intervals equivalent to the pitch of the stations. It was once almost universal practice for the transfer bar to be positioned on the centre line of the machine bed, under the work fixtures, where the pawls could readily engage the lower machined surface of a work piece or the trailing edge of a pallet. This method is still used but in several cases has been discarded in favor of the bar being placed to the side or above the workpiece, where it is more accessible and less prone to contamination by chips and coolant.

It is occasionally expedient to transfer components at an angle of inclination to the normal, to achieve a similar angularity in machining. In such cases the disposition of the transfer bar will undoubtedly be dictated by the inclination of the workpiece itself.

The ratchet method, once very popular, has perhaps dropped from favor due largely to the fact that the practical speed of transfer must be restricted. Too rapid a transfer will cause the components to over-run their locations. The ratchet system in its simplest form is

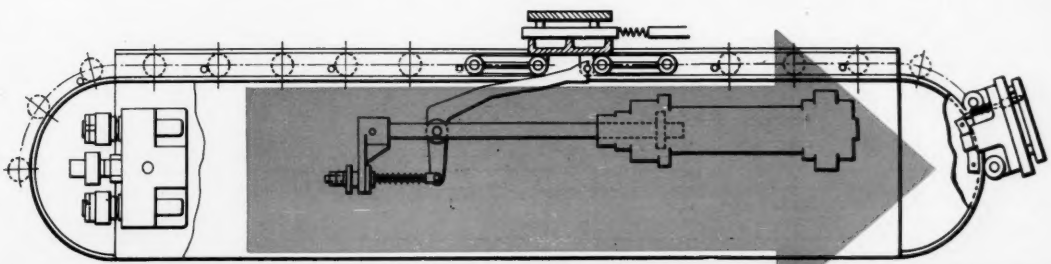

Fig. 1—An endless chain, carrying pallets, may be used in small transfer machines for light industry.

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incapable of controlling the deceleration in this respect. Transfer time, which is always unproductive time, can therefore be unduly prolonged.

2. Rotary bar.

The rotary bar method of transfer is a versatile system, adaptable to double indexing and lending itself to positioning in almost any location. The method uses a round section transfer bar to which are attached fingers. These fingers are arranged in pairs, one being to push the component and the other to check its deceleration and prevent over-running.

In operation, the transfer bar is first rotated by an increment sufficient to depress the fingers toward and between the components. The transfer bar then receives the necessary linear movement, at the end of which it is rotated in the opposite direction to clear the components and finally return to the start position. When used in conjunction with pallet type machines and mounted in the machine bed, the principle of operation of the rotary bar remains the same, an angular displacement of 90 deg. usually being sufficient.

3. Endless chain.

The endless chain method is well suited to the transfer of very small workpieces mounted upon pallets. Also, perhaps somewhat paradoxically, the method is adaptable to transfer of very large components such as tank hulls and other heavy ordnance equipment. In both these cases the chain advances at each cycle and does not return to the start position as do most other methods of transfer.

For the transfer of small components, a series of pallets is bolted at correct intervals on the run of a chain or other similar multi-hinged assembly. The chain, with pallets, is caused to advance at intervals of work station pitch in the usual manner, the pallets returning to the loading end on the underside of the return run of the chain. Many small typewriter, sewing machine and other similar components may be transferred by this method.

In all cases the design of the linkage must be such as to minimize stretch in the system for accurate station location. A form of adjustment is sometimes used or an automatic tensioner provided.

4. Lever type.

The lever type of transfer mechanism is designed to lift a component out of a vee, or other nesting location, and transport it bodily to the next station. The transfer bar then lowers, depositing the component into its new location. The transfer mechanism is thus doing the actual transporting and is not merely pushing or pulling the components over slides or guide-ways. In the lever type system therefore, the path of movement is not a simple linear one but a series of motions comprising raise, longitudinal travel, descent and final return to the start position.

The system is suited to those applications requiring relatively short transfer movement. An advantage, which may be valuable when machining soft materials, is the fac. that components are lifted from one station to the next. This obviates all possibility of damaging machined surfaces by components being slid along guide-ways.

5. Walking beam.

In applications requiring longer transfer strokes, while still retaining the compound motions of the lever system, the walking beam method offers advantages.

This method raises the transfer bar by levers, eccentric cams, or other method and while held in this position, the necessary linear motion is applied to effect transfer. At the end of the transfer stroke, the bar is lowered and the system returns to the start position.

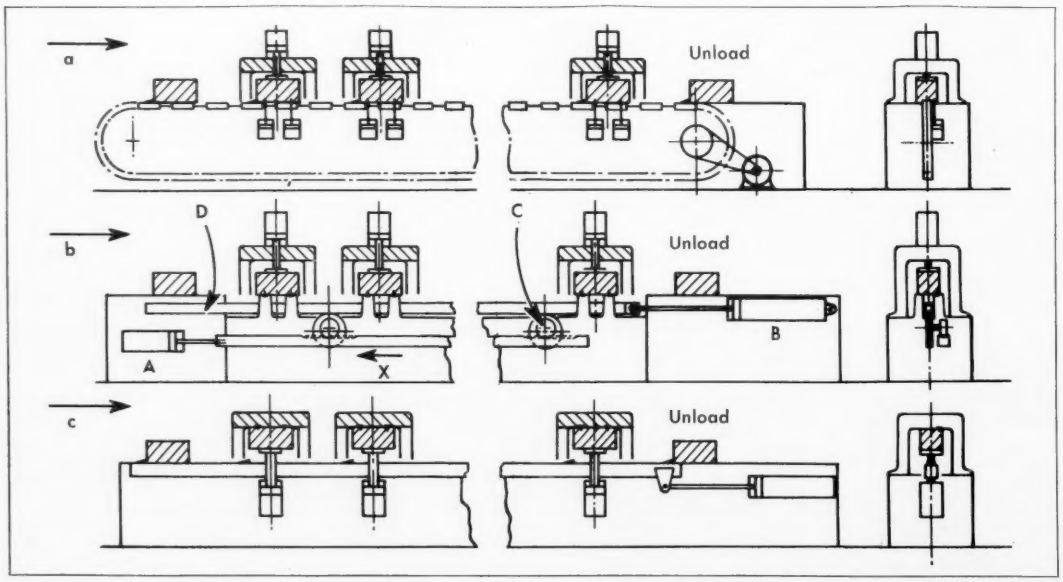


Fig. 2—Diagrams of simple ratchet type transfer mechanisms. Endless chains are used for all three.

Figure 1 shows perhaps the simplest method of transfer using the ratchet system. A pneumatic or hydraulic cylinder reciprocates at intervals to advance and retract the transfer bar. Reciprocating motion may be applied also by an electric motor and clutch mechanism, either by rack and pinion or through an endless chain arrangement.

The chain, attached to each end of the transfer bar, runs in the bed of the machine, suitably tensioned by spring-loaded take-up wheels. An electric motor or hydraulic rotary actuator, mounted at one end, is caused to drive the chain and so initiate linear motion in the transfer bar. At the end of the stroke the motor is reversed and the system returns to the start position.

Methods of actuation.

Sometimes one of the operations required on a given transfer machine is a slow one and will take longer to perform than the others. Under these conditions it becomes necessary to hold the slow operation for two cycles of the machine, while all other components are undergoing normal single cycle operations. If the long operation is performed on two components at two identical stations, output will still remain normal at one component per cycle. This concept is known as double or skip indexing and the rotary bar method lends itself particularly well in this direction.

Figure 3 shows a section through a rotary transfer bar, the fingers being in the neutral position. When the bar is rotated, causing the left finger to raise, all components will be transferred. When the bar is rotated in the opposite direction, causing only those fingers which include the shaded portion to raise, only selected components will be transferred.

In ratchet transfer methods, where the normal cycle components are clamped upwards and therefore clear of the transfer pawls, a similar method of double indexing is possible with the transfer bar operating twice at alternate cycles.

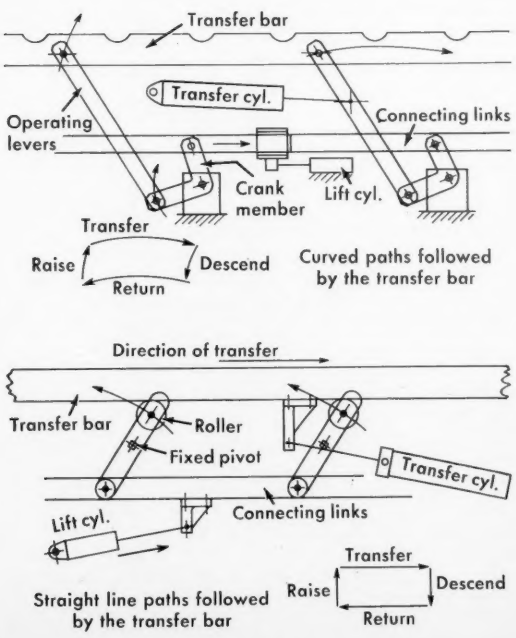
The main working parts of the lever type system are indicated in figure 4. The lift cylinder motivates the pivoted crank members. Cranks are fitted at intervals along the length of the machine and connected by a series of links. The radial movement at the outer end of the crank causes the operating levers, pivoted at the side of the transfer bar or bars, to raise, following the modified curve shown.

The linear transfer cylinder now operates and through the linkage the transfer bar is moved forward, again following the path of a section of arc. At the end of the transfer stroke, the lift cylinder exhausts and lowers the system, whereupon the transfer bar is retracted to the start position.

Figure 5 indicates a walking beam transfer method. It differs from the lever type in that no linkages are pivoted to the transfer bar. The linkages shown in the figure carry rollers, which, bearing on the underside of the transfer bar, raise the latter when the levers are motivated by the lift cylinder. The path of travel taken by the transfer bar when rising is a true straight line, as is the forward linear travel. Connecting rods operate all linkages simultaneously.

Figure 2b indicates a system whereby the lift motion is imparted by a series of eccentric cams, C, driven through rack and pinion from cylinder A. Linear movement of transfer bar D is controlled by cylinder B.

A wide field for ingenuity exists in the design of transfer mechanisms. Every machine design should be considered individually from the point of view of the intended transfer mechanism. It sometimes occurs that two or more systems prove equally suited to the duties involved. In other cases the choice will be limited to only one possible method. In all cases available space must be considered along with accessibility, the provision of ancillary services on the shop floor, customers' preference for a particular drive mechanism and, of course, the cost, safety and reliability in service. ★



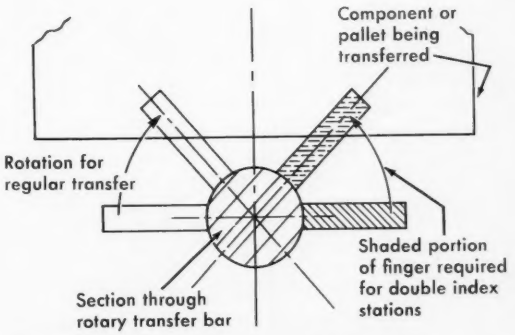


Fig. 3 (above) — Section through rotary type transfer bar showing finger in neutral position.

Fig. 4 (top left) — Diagram of lower type transfer mechanism shown in start position with arrows indicating paths followed at start of transfer cycle. Inset: paths followed during complete cycle.

Fig. 5 (left) — Diagram of walking beam type transfer mechanism using levers shown in the start position. Arrows indicate paths followed at start of cycle. Inset: paths followed during complete cycle.

Design Engineering opinion poll

Should P Eng Associations allow time at annual meetings for motions from the floor?

Harold P. Koehler, P.Eng.
Orenda Engines Ltd.
Toronto

Any professional engineering society that is solely a licensing body owes both its authority and its prime responsibility to the community and therefore has little need of concerning itself with representing the will or opinions of its licensees.

On the other hand, if an engineering society claims the right to represent the will and opinion of its members, and to act on their behalf, it must be subservient to their wishes.

A general meeting that does not allow the membership to question and direct the executive is merely an inefficient and expensive substitute for a written report.

It would not be just, however, in professional societies of widespread membership to make the general meeting the supreme authority. Proper referenda should be used for deciding all questions of fundamental importance such as by-laws and basic aims and objectives. So, although a general meeting should be able to direct the executive to conduct such referenda, the general meeting should not replace such referenda.

Sputnik
(Pseudonym for an Ontario Engineer)

I attended my first annual association meeting in 1960, and was shocked and disappointed. I had expected a high degree of participation by the membership at large, with spirited discussion of those problems facing the profession.

Instead I was subjected to a series of uninteresting summaries of reports (the actual reports were not available), an after-dinner speaker who lasted twice as long as he should have, and a sterile discussion by picked participants on a subject of which I soon forgot even the title.

To answer the question: "Yes, let's have discussion from the floor. It couldn't be any worse than what we have now."

Opinion Poll is a sampling of readers' views on questions of current interest to engineers. At least we had assumed that this month's question was one of current interest in view of developments in Ontario (discussed in our editorial in September and subsequently in the correspondence column). But if it does hold any interest, many readers found no interest at all in expressing answers in public. Hundreds declined. For editorial comment see Backlash under the heading "Could you answer?"

John Greenaway, P.Eng.
Alpha Manufacturing
Winnipeg, Man.

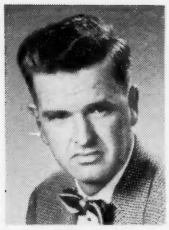
There are a number of possible complications inherent in any plan to permit the wholesale presentation of motions from the floor at meetings of any kind. The most obvious of these are the shortage of time available for the presentation and discussion of such motions.

I personally feel that regardless of such complications it is the duty of an organization to make provision for any of its members to put forward motions at a time and place when they have a maximum number of members as an audience. In the case of a provincial Association of Professional Engineers the annual meeting is usually the only occasion on which such an opportunity presents itself.

Even with suitable steps being taken to overcome the complications referred to above, an argument may be put forward that any worthwhile motions could be presented through the appropriate channels and committees. With this argument I would strongly disagree as I have found that many younger members of the associations feel a lack of identity with the membership at large and would be very unlikely to approach committee members with proposals. Yet these younger members may have many useful ideas to contribute, either during a discussion of someone else's motion, or to present on their own if given suitable encouragement.

U.S. firms wouldn't tackle it, European prices were too high, then they offered the job to a Canadian designer

CGE builds largest outdoor capacitor



The man who designed it.

Three capacitors built in Toronto for a U. S. transmission system represent a Canadian design triumph and a "world first". Capacitors of this voltage have never previously been built for outdoor installation.

The Canadian-designed units were manufactured by Canadian General Electric Co. Ltd. at its Davenport instrument transformer works in Toronto. They play a key role in the Pittsfield extra high voltage prototype transmission system being constructed by General Electric near Pittsfield, Mass., to test the feasibility of extra high voltage power transmission.

A key element of the Pittsfield project is a highly accurate system of power loss measurement. If the instrumentation equipment itself permitted power loss, then calculations vital to the future of EHV transmission would be open to serious error.

General Electric engineers in the U. S. developed a low-loss method of checking power loss, but the method involved the use of an extra-high-voltage capacitor of a size not in existence. They reasoned that it could be developed, but their own facilities and engineering staff were too heavily committed to other projects to take on the job.

They said no

A search of U. S. and European manufacturers and designers failed to turn up anyone willing to accept the assignment. One European manufacturer offered to build an indoor capacitor meeting most of the requirements, but his cost was considered excessive.

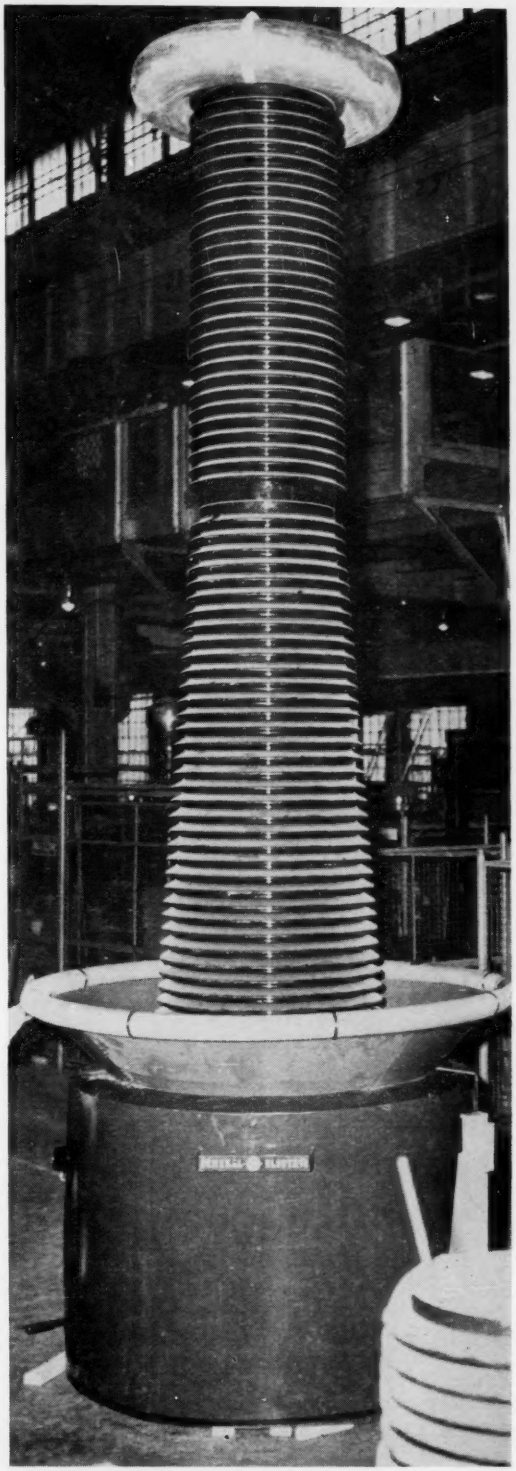
General Electric then approached its Canadian associate. C.G.E. accepted the job, glad of the experience in producing such EHV equipment.

The project was turned over to Howard Lucas, high voltage instrument transformer engineer and a top-rated man in his field. His assignment was to design and supervise the production of three low-loss capacitors for outdoor installation and on voltages up to 750 kv.

Even shipping was problem

The capacitors were ready for final testing last summer, including tests at 2¼ million volts. But even then there were problems to overcome. The height of the capacitors (19 ft) prevented upright shipping, so cradles had to be constructed to transport them in a horizontal position. The cradles had to be so designed that there would be positively no movement in shipping.

Lucas solved this problem by placing six rubber air-filled mattresses under each cradle. The mattresses were inflated at low pressure and provided the required cushioning for the 4½-ton load. ★



Frank Long, a certified engineering technician, is soils dimensioning supervisor with the Department of Highways of Ontario. Here he adjusts equipment in the soils lab.

***Second of two parts**

The engineering technician— his present and his future

Ontario leads the world in organized development program through APEO

B. H. Goodings, P.Eng.
Field representative
A.P.E.O.

Do you remember what happened in 1956? It was the year when attention of the public was drawn to the frightening consequences of a "shortage of engineers." The press gave wide coverage to the meeting of educators and industrialists at St. Andrews-by-the-Sea and were suitably shocked when the Honorable C. D. Howe, P.Eng., Minister of Trade and Commerce, rocked the meeting by pointing out that in his opinion there was no "shortage of engineers."

While it may not have been evident at the time there is little doubt now that Mr. Howe was right. The shortage was not of engineers, but of engineering technicians. Industry, faced with an ever-increasing demand for men with technical training, and with a dearth of technicians, had employed professional engineers to fill the gaps.

It has become so commonplace to fill a technical job with an engineer that **the concept of what an engineer is trained to do has faded into obscurity.** Many university graduates, finding themselves in jobs for which their training did not fit them, have failed to perform adequately and have never emerged from the junior positions into which they were put on graduation.

The publicity and attention given to the need for technically trained employees has completely ignored the skilled technician and has concentrated on the more glamorous title "engineer." Our engineering schools have blossomed and thrived, but the education of engineering technicians has been more or less ignored and until the late 1940's was almost non-existent.

In spite of this Canadian industry benefits daily from the work of a few who have educated themselves, who have taken every opportunity to learn and who are performing as the highly skilled engineering technicians Canada needs. Now, new blood is flowing into industry as graduates go forth from our Institutes of Technology. These were pioneered by the Ontario Department of Education and are being used as a pattern throughout Canada and the United States. These young men are being supplemented by others who left High School early but who have now returned to technical evening classes.

APEO takes the lead

It was in 1956 that the Association of Professional Engineers of Ontario began to look into this matter of engineering technicians. It was evident that something should be done to recognize the growing group of technicians who were making such important contributions to industrial progress.

A committee under the chairmanship of Dr. G. B. Langford, P.Eng., put in months of study, consulting with the Department of Education and with the leaders of the Ontario Government. It was agreed that the engineering profession in Ontario could provide a much needed service to the public and, in particular, to engi-

**The first half of this report appeared in DE, August 1960, page 44.*

neering technicians if it could assist in providing recognition and encouragement.

In June, 1957, a certification program for engineering technicians was announced by the APEO and Ontario's Premier, the Honorable Leslie Frost, Q.C., gave it his blessing by personally presenting the first six certificates.

From the outset it was recognized that an organization of engineering technicians would grow from the seeds sown by the engineering profession; but before such an organization could become self-supporting a great deal of time, effort and money would be required. This the engineers gave without hesitation.

The certification program is now entering its fourth year. Giant strides have been made and even greater progress is expected.

A typical course . . .

MECHANICAL TECHNOLOGY

Behind the machines and the machines which make the machines is an army of men and women who operate and control them. Behind both the machines and the operators, however, are the trained technical personnel who specialize in the organization, direction, supervision, designing, planning and expediting required, and in the performance of the many other responsible duties which are necessary for the smooth functioning of the nation's complex industrial organization.
In the Mechanical Technology course, which has been designed in close collaboration with leading industrialists, the student is given that sound background upon which later specialization can be readily built. It requires abilities in science and mathematics as well as an aptitude for the solution of problems of a mechanical nature.

Program of Studies

	Hrs. per wk.	
First year		
Subject	Lect.	Lab.
Chemistry	3	2
Electricity and Magnetism	3	2
Engineering Drawing	–	3
English	4	–
Mathematics	5	–
Physics	3	2
Physical Education	–	2
Orientation	1	–
	19	11
Second year		
English	3	–
Mathematics	4	–
Economics	2	–
Applied Mechanics	4	2
Mechanics of Materials	3	–
Metallurgy and Welding	2	5
Manufacturing Processes	2	3
	20	10
Third year		
English	2	–
Mathematics	3	–
Mechanics of Materials and Machines	4	2
Machine Design	–	6
Applied Thermodynamics	2	2
Tool Design	–	3
Metrology	–	2
Mechanics of Fluids	2	2
Technical Report	–	–
	14	16

Courtesy Ryerson Institute of Technology, Toronto.

How does it work?

Four levels of engineering technicians have been established: Engineering Technicians Grades 1, 2, 3 and Engineering Technologist. Each of these grades represents a **definite level of academic background combined with experience** and a syllabus of examinations has been set up to provide a guide to further study.

Engineering Technician Grade 1 is the lowest level, requiring the completion of Grade XII in a secondary school and two years of applicable experience. This grade was established to attract young men who leave school at Grade XII and who find themselves working in an engineering office. Perhaps it will apply to the young man who operates the blue-print machine or performs as a junior draftsman. The main interest here is to offer him the encouragement and guidance he needs to improve and advance himself.

The next level, Engineering Technician Grade 2 represents one additional academic year beyond Grade XII plus two years of experience. This might include those who have completed Grade XIII or who have qualified for an Ordinary National Certificate in Great Britain. Holders of the Advanced Technical Evening Class Grade 1 Certificate also qualify in this grade, provided they have the necessary experience.

The Grade 3 level represents two academic years beyond Grade XII, such as the completion of one year of an engineering course, two years at an Ontario Institute of Technology, a Higher National Certificate or the Advanced Technical Evening Class, Grade 2 Certificate. This latter group also qualify for additional academic credits towards Engineering Technologist.

The goal of Engineering Technicians is the senior grade of Engineering Technologist. The title has been adopted to set it apart as a level of academic excellence and to offer due tribute to the men who achieve the goal. It represents three academic years beyond Grade XII, such as two years of an engineering course, or graduation from an Ontario Institute of Technology (three year course). Qualification as an Ingenieur in Germany is also accepted at this level.

The Panel of Examiners and Certification Board

When an application is received it is seen first by the Panel of Examiners who assess it strictly on the basis of academic standing. It then passes to the Certification Board who consider it from the joint aspects of academic background and experience.

Because there are so many men in the industry who are self-educated, attention must be paid to the progressive increases in responsibility of each applicant. The Board recognizes experience in lieu of formal academic training up to the level of Engineering Technician Grade 3. For certification as an Engineering Technologist each applicant must show proof of having met the required academic standards, or be prepared to write examinations as required by the Certification Board to establish that he possesses the qualifications.

It is therefore possible for those who have not had the benefit of formal education up to or beyond the Grade XII level to receive fitting recognition of their qualifications, provided that their experience and their performance indicate that such recognition is merited.

continued ▶

When the Board decides upon the classification of an applicant it also approves an examination program, which, when completed by the technician, will qualify him as an Engineering Technologist.

Each engineering technician is, therefore, told where he stands academically and he is encouraged to take advantage of night classes or correspondence schools to improve himself. He may write examinations sponsored by the Ontario Department of Education or, if he takes a correspondence course, he may write examinations set by the APEO for his convenience. As he obtains the necessary academic qualifications for the next higher grade he may be reclassified.

The certification program was set up to recognize and give encouragement to those who assist professional engineers in carrying out their professional duties. The Certification Board maintains a strict policy of requiring that all applicants be working under engineering supervision. If an individual is working at a job which, at one level or another, requires engineering supervision, he may be certified as an Engineering Technician.

Where are they going?

In the early stages of development, elected representation by engineering technicians or technologists was impossible. Nevertheless it was important that representation be effected as soon as possible and certified men have been invited to become members of both the Panel of Examiners and the Certification Board.

To develop leaders for a future organization and to permit engineering technicians to take a part in the development of their own program an Advisory Committee was set up in 1958 under the chairmanship of F. A. Beeby, Engineering Technologist of Belleville. Representatives on this Advisory Committee are A. M. Jacobs, Port Colborne, H. P. Lansing, London, C. A. MacMillan, Sudbury, N. H. Kangas, Toronto and E. W. Gordius, Toronto.

As a result of the work of this Committee local groups of engineering technicians now exist in Chatham, London, Ottawa, Sudbury and Toronto. Representatives to the Advisory Committee thus form a direct link with the membership and provide a voice in the operation of the program.

Recent activities of the Advisory Committee have resulted in proposals for a self-governing organization of Engineering Technicians and Technologists. Much work is yet to be done on this development but there is little doubt that the near future will see a new and fast-growing organization take form.

Benefits of certification

No one can hold out promises of more pay or increased status to those who go through the routine of certification. Certainly industry is interested in having a measuring stick against which a man's qualifications can be assessed for employment or for promotion. They are interested, too, in the incentive which makes technicians go back to school to earn classification in a higher grade.

To the Engineering Technician or Technologist the aim of the certification program is to earn the recognition of industry and of the public. To do this, there must be a strong organization supported by each individual who seeks recognition.

Tangible benefits take the form of participation in the APEO's Group Insurance Plan, Retirement Savings Plan and the Engineers' Equity Fund.

In three years, participation in the program has risen to 1,300. Applications are being received at an increasing rate and with increased membership will come the opportunities to increase services and to provide an active public relations program.

For further information on the engineering technician program in Ontario, circle 371 on the Reader Service Card.

Engineering technician S. L. McKee works in the engineering standards department at CGE, Peterborough, Ontario. His duties include maintenance of standards for stock materials and standardized designs for nameplates. He is also a member of the Standards Engineers Society.

Shortcuts to maxima, minima problems

Partial differential reduces calculations; it's easier than it sounds

W. H. Sheppard, B.Sc.

III. USE OF PARTIAL DIFFERENTIATION

It will be realized (when considering the previous examples) that the greatest difficulty occurs when regarding either the volume or surface area as a constant. Use of partial differentiation, however, eliminates or reduces this difficulty.

To understand how to perform this operation a simple example will be taken. Consider a cone of radius 'r' and height 'h'.

Volume $V = \frac{1}{3}\pi r^2 h$, V being a function of r and h.

If h is regarded as a constant, however,

$$dV/dr = 2\pi rh,$$

and this is written as

$$\partial V/\partial r = \frac{2}{3}\pi rh, \textit{ the partial differential coefficient of } V \textit{ with respect to } r.$$

If, on the other hand, r is regarded as a constant:

$$\partial V/\partial h = \frac{1}{3}\pi r^2, \textit{ the partial differential coefficient of } V \textit{ with respect to } h.$$

Part 1 of this article appeared in September, 1960.

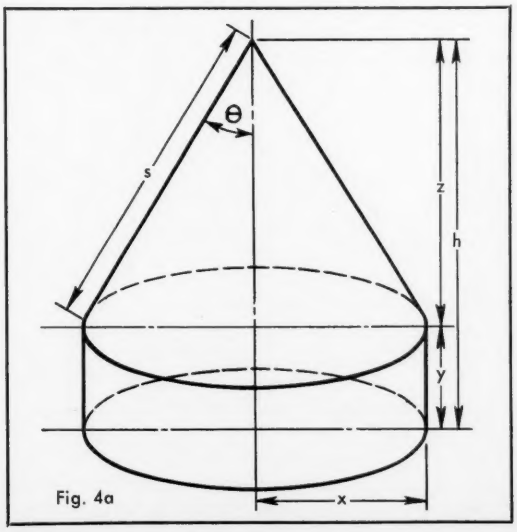


Fig. 4a

It is generally shown in books on calculus that

$$\frac{dV}{dr} = \frac{\partial V}{\partial r} + \frac{\partial V}{\partial h} \cdot \frac{h}{dr}$$

$$\text{or } \frac{dV}{dh} = \frac{\partial V}{\partial r} + \frac{\partial V}{\partial h} \cdot \frac{dh}{dr}$$

Thus, if the relation between h and r is known, $\frac{dV}{dr}\left(\text{or } \frac{dV}{dh}\right)$ may be deduced.

In general, let $F = F(xy)$ which in the present type of problem will be the volume, V. Let $f = f(xy)$ which in the present type of problem will be the surface area, A.

Usually it is not readily possible to determine dy/dx directly from either equation, but again it is shown in books on calculus

$$\frac{dy}{dx} = -\frac{\partial A/\partial x}{\partial A/\partial y}$$

(the negative sign should be noted)

Considering $F(xy)$,

$$\frac{dF}{dx} = \frac{\partial F}{\partial x} + \frac{\partial F}{\partial y} \cdot \frac{dy}{dx}$$

$$= \frac{\partial F}{\partial x} - \frac{\partial F}{\partial y} \cdot \frac{\partial f/\partial x}{\partial f/\partial y}$$

Then, equating to 0,

$$\frac{\partial F/\partial x}{\partial F/\partial y} = \frac{\partial f/\partial x}{\partial f/\partial y}$$

If 2 or more variables x, y, z . . . are considered it

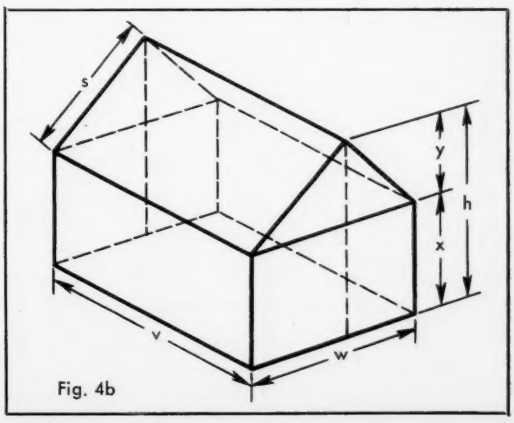


Fig. 4b

may be inferred:

$$\frac{\partial F/\partial x}{\partial f/\partial x} = \frac{\partial F/\partial y}{\partial f/\partial y} = \frac{\partial F/\partial z}{\partial f/\partial z} \cdots$$

To illustrate the application of this formula a simple example will be taken.

Cone with open end (as for figure 3c)

$$V = \frac{1}{3}\pi r^2 h$$

$$\partial V/\partial r = \frac{2}{3}\pi rh$$

$$\partial V/\partial h = \frac{1}{3}\pi r^2$$

$$S = \pi r(r^2 + h^2)^{\frac{1}{2}}$$

$$\partial S/\partial r = \pi[r^2(r^2 + h^2)^{-\frac{1}{2}} + (r^2 + h^2)^{\frac{1}{2}}]$$

$$\partial S/\partial h = \pi r(r^2 + h^2)^{-\frac{1}{2}}$$

$$\frac{\partial V/\partial r}{\partial V/\partial h} = \frac{\partial S/\partial r}{\partial S/\partial h}$$

$$\frac{2h}{ry} = \frac{2r^2 + h^2}{rh}$$

$$h^2 = 2r^2$$

$$\frac{r}{h} = \frac{1}{\sqrt{2}}$$

$$\therefore \theta = 35° 16', \text{ as before.}$$

Some examples of tents will now be considered, but, as stated previously, the results obtained may be applied to many other engineering constructions.

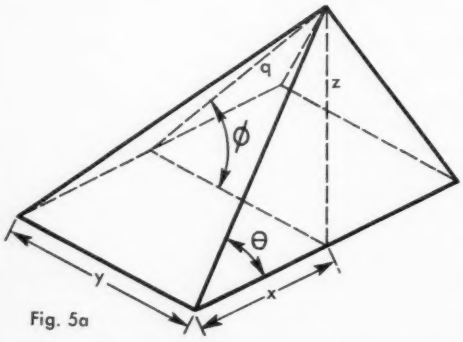


Fig. 5a

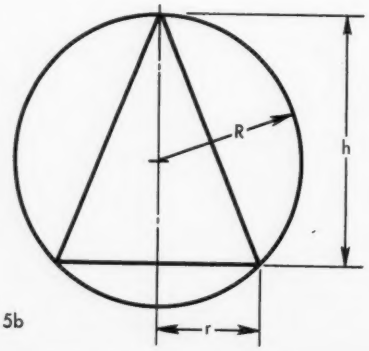


Fig. 5b

Bell tent (Figure 4a)

May be considered as either circular or polygonal.

$$V = kx^2\left(y + \frac{z}{3}\right)$$

$$A = 2k\left[xy + \frac{1}{2}x(x^2 + z^2)^{\frac{1}{2}}\right]$$

$$\frac{\partial V}{\partial x} = 2k\left(y + \frac{z}{3}\right)$$

$$\frac{\partial A}{\partial x} = 2k\left[y + \frac{1}{2}\frac{x^2}{s} + s\right]$$

$$\frac{\partial V}{\partial y} = kx^2, \quad \frac{\partial V}{\partial z} = \frac{kx^2}{3}$$

$$\frac{\partial A}{\partial y} = 2kx, \quad \frac{\partial A}{\partial z} = 2k\left[\frac{xz}{2s}\right]$$

$$\frac{2x\left[y + \frac{z}{3}\right]}{x + \frac{1}{2}\left[\frac{x^2}{s} + s\right]} = \frac{x^2 \cdot 2s}{3xz}$$

whence, by simplification,

$$\cos\theta = \frac{2}{3} \quad \text{and } h = s, \text{ the slope height.}$$

The result is a shape which would touch a hemisphere at 2/3 the distance down the sloping sides, that is, at the centre of elemental area. It may be shown similarly that, if the floor covering is included in the total area, the result is a shape which would touch a whole sphere at this point.

Cottage tent (Figure 4b)

$$V = 2vwx + vwy$$

$$A = 2vx + 4wx + 2v(x^2 + y^2)^{\frac{1}{2}} = 2wy$$

$$\frac{\partial V}{\partial v} = w(2x + y), \quad \frac{\partial V}{\partial w} = v(2x + y)$$

$$\frac{\partial V}{\partial x} = 2vw, \quad \frac{\partial V}{\partial y} = vw$$

$$\frac{\partial A}{\partial v} = 2(x + s), \quad \frac{\partial A}{\partial w} = 2\left(2x + \frac{vw}{s} + y\right)$$

$$\frac{\partial A}{\partial x} = 2(v + 2w), \quad \frac{\partial A}{\partial y} = 2\left[\frac{vy}{s} + w\right]$$

$$\frac{w(2x + y)}{x + s} = \frac{v(2x + y)}{2x + \frac{vw}{s} + y} = \frac{2vw}{v + 2w} = \frac{vw}{\frac{vy}{s} + w}$$

whence, by simplification, $s = 2y$ & $x = y$.

The tent thus is half a regular hexagonal prism whose length is equal to its width, giving a square plan and the sides are tangential to a hemisphere at their centres. For these purposes centres of vertical sides are considered at the centre of double area. If the sides in this case were allowed to slope the result would be one half an octagonal prism.

Curiously, although in this case the vertical angle is different from the previous example, the slope height is again equal to the vertical height, this being a general property of any such tangent drawn to a circle.

In the case of a simple bivouac tent, the result is a diagonal half of a cube. If the flooring is con-

sidered, the result is a triangular prism of length 2/3 the height.

An example where the general condition of tangency to a sphere cannot be obtained will now be considered.

Pyramid tent (Figure 5a)

$$V = \frac{1}{3}xyz$$

$$A = \frac{1}{2}\left[xy + y(x^2 + z^2)^{\frac{1}{2}} + x(y^2 + z^2)^{\frac{1}{2}}\right]$$

$$\frac{\partial V}{\partial x} = \frac{1}{3}yz; \quad \frac{\partial V}{\partial y} = \frac{1}{3}xz; \quad \frac{\partial V}{\partial z} = \frac{1}{3}xy$$

$$\frac{\partial A}{\partial x} = \frac{1}{2}\left[z + xy(x^2 + z^2)^{-\frac{1}{2}} + (y^2 + z^2)^{\frac{1}{2}}\right]$$

$$= \frac{1}{2}\left[z + \frac{xy}{p} + q\right]$$

$$\frac{\partial A}{\partial y} = \frac{1}{2}\left[(x^2 + y^2)^{\frac{1}{2}} + xy(y^2 + z^2)^{-\frac{1}{2}}\right]$$

$$= \frac{1}{2}\left[p + \frac{xy}{q}\right]$$

$$\frac{\partial A}{\partial z} = \frac{1}{2}\left[x + yz(x^2 + z^2)^{-\frac{1}{2}} + xz(y^2 + z^2)^{-\frac{1}{2}}\right]$$

$$= \frac{1}{2}\left[x + \frac{yz}{p} + \frac{xz}{q}\right]$$

$$\frac{yz}{z + \frac{xy}{p} + q} = \frac{xz}{p + \frac{xy}{q}} = \frac{xy}{x + \frac{yz}{p} + \frac{xz}{q}}$$

$$\text{whence, } \frac{z}{y} + \frac{x}{p} + \frac{q}{y} = \frac{p}{x} + \frac{y}{q}$$

$$\therefore \tan\phi\,(1 + \sin\phi) = \frac{\sin^2\theta}{\cos\theta}$$

$$\text{and } 1 + \frac{xy}{pz} + \frac{q}{z} = 1 + \frac{yz}{px} + \frac{z}{q}$$

$$\therefore \cos\phi = -\frac{\cos 2\theta}{\cos\theta}$$

and by crossplotting and repeated calculation

$$\theta = 57^\circ\ 23'; \quad \phi = 39^\circ$$

Finally, a different type of problem is considered which although, as given, is largely academic in character, illustrates how partial differentiation and the formula previously obtained may be otherwise used.

Largest cone in a sphere (Figure 5b)

In the first instance the area is not considered but the volume of the cone and the radius of the sphere are taken as the two variable functions.

$$V = \frac{1}{3}\pi r^2 h$$

$$R = \frac{h^2 + r^2}{2h} = \frac{h}{2} + \frac{r^2}{2h}$$

$$\frac{\partial V}{\partial r} = \frac{2}{3}\pi rh, \quad \frac{\partial V}{\partial h} = \frac{1}{3}\pi r^2$$

$$\frac{\partial R}{\partial r} = \frac{r}{h}, \quad \frac{\partial R}{\partial h} = \frac{1}{2}\left(1 - \frac{r^2}{h^2}\right)$$

$$\frac{2\pi rh^2}{3r} = \frac{2\pi r^2 h^2}{3(h^2 - r^2)}$$

$$h^2 - r^2 = r^2$$

$$h = \sqrt{2r}$$

$$\theta = 35^\circ\ 16'$$

as for largest cone for given area of curved surface.
To find the cone with the largest area of curved surface,

Curved Surface $S = \pi r(r^2 + h^2)^{\frac{1}{2}} = \pi rs$

$$\frac{\partial S}{\partial r} = \pi\left[\frac{r^2}{s} + s\right]; \quad \frac{\partial S}{\partial h} = \frac{\pi rh}{s}$$

and by similar calculation $\theta = 35^\circ\ 16'$ as before.

Miscellaneous other problems

By similar calculation the following results have been obtained and are given for reference.
Cylinder, height 'h' and radius 'r' in sphere of radius 'R'.

Largest volume, $h = \sqrt{2r}$

Greatest curved surface, $h = 2r$

Greatest total surface, $r/h = \dfrac{1 + \sqrt{5}}{4} = 0.81$

Greatest surface including one end only, $r/h = \dfrac{1 + 2\sqrt{5}}{8} = 0.684$

Cylinder, height 'h' in cone, height H.

Largest volume, $h = \frac{1}{3}H$

Greatest curved surface $h = \frac{1}{2}H$.

Conclusion

It will be seen from the foregoing that, in general, partial differentiation may considerably shorten calculations required to determine the most economical proportions for sheet metal work and analogous problems. Where possible, centres of area should touch an imaginary sphere (or elements in the case of curved surfaces).

It may also be shown that certain nearest approaches to this condition may also be applied. For example, if a tubular container has conical ends, these should touch a sphere of equal diameter at each end 2/3 down the slope length of the cone, irrespective of the length of the container. Similarly the roof of a house should have the slope and length as for a cottage tent, but either of these conditions may be applied independently. In the design of ductwork and the like it will be inferred that the most economical is that which will pass a sphere, if possible at the centres of area of the surfaces of their elements, otherwise elliptical or polygonal sections should be considered.

When this general condition is not possible, fundamental calculations employing the formula derived for applying partial differentiation as in the pyramid tent must be used. Unfortunately this may entail a considerable amount of repetitive calculation, but the results in general provide appreciable economy of design and the effort will be found worth while. ★

Figure 1 — Cutaway section of Helen Curtis "Mist-O-Matic" vaporizer reservoir assembled with chemical adhesives. The manufacturer effected a considerable saving in cost over the high heat seam welding method of assembly.

First of three parts

Designing for chemical welding

H. J. Jankowski, B.Sc.

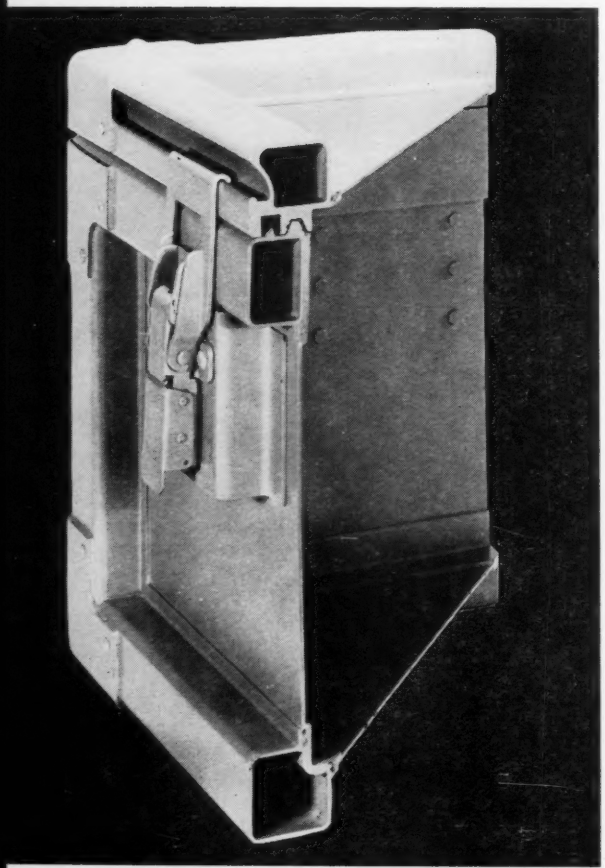


Figure 2 — The use of adhesives to assemble modular shipping containers reduced design and production costs approximately 25%.

"Chemical welding" is a term for the latest technique of joining metals, reinforced plastics and other materials with high-strength structural adhesives.

Until recently, adhesive progress has been slow. Designs were such that adhesives carried little, if any, load. Also, at least one of the adherents had to be porous to allow the escape of solvents.

Developments in the last few years in polymer chemistry and the commercialization of many new resins have greatly increased the selection of raw materials available for adhesives. These new materials make it possible to formulate adhesives with load-bearing ability. By varying the selection of thermosetting and thermoplastic resins, elastomers and fillers, adhesive properties of flexibility, heat and cold resistance, exposure resistance, shear strength, dead-load strength and peel strength can be greatly modified.

Three general types of adhesives are commercially available that will produce high-strength structural bonds. Each type offers certain advantages over the other two.

Film adhesives

Elastomer-phenolics offer good flexibility, vibration absorption and peel strength. They have excellent resistance to fuels, lubricants, humidity and salt spray. This type of adhesive is characterized by a rather flat, slowly descending curve when shear strength is plotted against service temperature.

Generally made in the form of a dry film having controlled thickness and width, films are placed on a nonadhering liner and stored in rolls. When properly stored, these adhesives remain stable and usable for long periods of time.

Film adhesives provide uniform adhesive thickness throughout the joint, controlled confinement of adhesive to the immediate bonding area, clean bonding operations and simple application procedures. They do not contain solvents, which eliminates fume disposal and drying problems. Available in varying widths and thicknesses, they can be die-cut into complicated shapes if desired.

Man's first contact with adhesives was when he cut himself and had the dried blood bond the skin suit he was wearing to his body. Next he noticed insects, leaves and rodents trapped by pitch or gums from various trees. So the study of adhesives began and has been carried on through the ages. History tells us that more than 6,000 years ago adhesives were used, but the first recorded evidence goes back only 3,000 years and this is from Egyptian hieroglyphics. The first evidence of a nonanimal glue appeared in 1754 when a British patent was granted for the manufacture of a "Kind of Glue Called Fish Glue." Inorganic silicate type of adhesives came about the same time. About 10 years later came the rubber and resin adhesives. This article considers the factors involved in the selection of structural adhesives, the general types of adhesives available to the designer and their advantages. Future articles will give design considerations by which adhesives can be employed, the preparation necessary, the equipment and representative application of the technique.

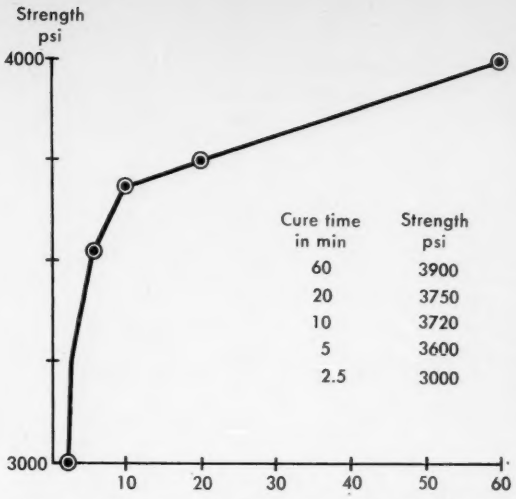


Figure 3 — Strength of a typical thermosetting adhesive. Note the steep slope of the curve at left of graph.

Thermosetting film adhesives require both heat and pressure to accomplish the bond. Pressure is needed to bring the parts into contact, as with other methods of joining, and to contain the volatile byproducts given off by the curing reaction. If pressure is not maintained during the cure this vapor will cause a porous bond. Pressure of 25 to 150 psi are required depending on the rate of heat input to the bond line and the composition of the adhesive.

The application of heat, for example, produces many changes in Scotch-Weld film adhesives. At temperatures of 160F to 180F heat causes surface tack. This makes it possible to heat tack the film adhesive in place on the adherent prior to bonding.

Between 180F and 210F the adhesive becomes thermoplastic and wets the adherend. All the pressure used in the bonding process should be uniformly applied to the part before the bond line reaches 180F. This pressure forces the adhesive in its thermoplastic state to flow, wet and fill small, mismatched areas.

Actual cross-linking reaction begins between 220F and 250F. It is 90% completed at 300F. However, the toughness is developed under temperatures of 325 to 350F. Maximum strength is obtained with an optimum cure of one hour at 350F under 100 psi pressure.

High bond strength in excess of 2,500 psi tensile shear strength can be obtained with a cure time as low as 2 to 3 minutes at temperatures of 400 to 450F.

One-component adhesives

Modified epoxy-resin based adhesives, whether heat curing or room temperature curing, offer high strength, resistance to creep under constant stress and exceptional adhesion to most surfaces. They are self-filleting which makes them excellent for use with honeycomb sandwich construction.

Both heat curing and room temperature curing varieties are 100% nonvolatile liquids or semiliquids. Since no gaseous byproducts are given off during the curing cycle, they are an excellent choice for bonding impervious surfaces. The paste-type have excellent void-filling properties and are useful for structural joining of loosely fitting parts. Epoxy-resin based adhesives require only contact pressure during the cure, eliminating the need for elaborate and expensive jigs and fixtures.

One-component, heat curing, modified epoxy resin adhesives contain a latent hardener that is added to the formulation at the time of manufacture. The hardener in 3M's one-part epoxy is activated by high temperature, usually 300F or higher, making it necessary to expose the adhesive to a heat curing cycle to cure.

Because they are one-component, this type of adhesive eliminates the need for accurate weighing and mixing of the hardener and base resin by the user. Besides saving time and minimizing the possibility of human error, this system allows an unlimited working life, something that may be a problem with the two-component, job-site mixed, epoxy resin adhesive system.

Two-component adhesives

A two-component, modified epoxy adhesive consists of a base resin and a separate liquid catalyst or curing agent. The two parts must be mixed in the proper proportions just prior to use in order to obtain a cure. As soon as the two parts are mixed in a container, the curing action begins, slowly at first, and then more rapidly if the mixture is not kept cool. Heat causes the cure to proceed more rapidly, and, since the chemical reaction is exothermic, it is necessary to keep the temperature to a minimum by limiting the size of the batch, cooling the batch artificially by refrigeration, or spreading the batch in a thin film to dissipate the heat.

Two-component, modified, epoxy systems will cure at room temperature, making them useful for many bonding operations where heat or pressure are not feasible in making a sigh strength bond. A rapid cure can be obtained after the parts are assembled by merely heating the assembly in an oven, under infra-red lamps, or by dielectric or induction heating apparatus.

Structural adhesives, fundamentally, are load-bearing and contribute strength to the structure. Knowledge of adhesive types, design principles and fabrication

techniques must be considered concurrently in order to utilize structural adhesive joining to its maximum.

New design concept

The use of load-bearing adhesives was pioneered by the aircraft industry. The continuing goal in this industry is to develop aircraft that will fly higher and faster, yet be stronger and lighter in weight. To accomplish this, a new structural design concept was required as well as the use of thinner gauge metals. This presented an assembly problem that could only be solved by adhesive bonding. For example, most of the recently developed B-58 and the new jet commercial aircraft utilize honeycomb construction.

Structural adhesives are available as adhesive films of uniform thickness and weight that cure with heat and pressure, as one-part heat curing liquids, or as two-part, room temperature curing liquids.

With this variety of physical forms available, a structural adhesive system can be found that will meet nearly all production and performance requirements, and the designer or design engineer is provided with a high-strength joining method possessing many advantages.

There are, basically, five advantages of adhesive bonded assemblies.

1. Adhesives produce continuous bonds and thus distribute stress loads evenly over the entire joined area. This eliminates local stress concentrations, produces joints of greater strength and rigidity, and permits the use of lighter gauge materials.

In other words, with structural adhesives there are no stress concentrations at the points of attachment and the full strength of the thinnest sheets can be utilized. This factor often allows a reduction of metal thickness or size of joint, which results in weight and cost savings.

2. Because the adhesive film is continuous between mating surfaces, sealing as well as bonding is achieved in a single operation. This eliminates time and cost of separate sealing operations and permits the sealing of joints where it might not otherwise be possible. This sealing characteristic also eliminates entrapment of corrosive moisture in the joint area.

For example, the new Convair 880 jet transport utilizes almost all of the space inside its wings to carry fuel. This is achieved by the use of a bonding film put in the wing skins, spars and bulkheads.

As well, adhesives make it possible to join dissimilar metals with a minimum of bimetallic corrosion by acting as a continuous insulating barrier between the surfaces.

3. Adhesives maintain integrity of structural members. Holes for the insertion of fastening devices are eliminated, counter-sinking to give a flush surface is unnecessary, and excessive heat of fusion joining (which can ruin heat treatment or distort parts) is eliminated.

4. Adhesive bonded joints eliminate gaps and bulges common with intermediate fastenings, have no external projections as with rivets and bolts, and have no surface mars due to the heat and pressure of spot welding. These properties are important where a smooth surface is desirable and where styling is considered on a par with product performance.

5. Adhesive compositions, due to their inherent mechanical properties, permit high extensions and recovery under repeated loadings. This energy absorption or damping property, accounts for the vastly superior fatigue life of an adhesive assembly.

In one laboratory test studying joint fatigue life on identical detail parts results were as follows:

	Chemical-curing		Elastomeric-phenolic
	Two component	One component	
strength/psi			in shear/psi
at 75F	2500-3500	3000-5000	3000-4000
at 180F	800-1500	———	———
at 300 F	———	1500-2500	———
at 350F	———	———	2000-2500
flexibility	good	good	excellent
peel resistance	poor-fair	fair-good	excellent
water resistance	fair-good	excellent	excellent
fuel resistance	excellent	excellent	excellent

Figure 4 — Physical properties of three different chemical adhesives marketed by the 3M Company.

Method	Cycles to Fail
Spot welded joints	12,000,000
Riveted joints	18,000,000
Adhesive bonded joints	240,000,000

Selecting the right adhesive

The important matter of selecting the right adhesive for each type of service is not a simple procedure.

Applications must be studied to determine which properties and conditions are most important and limiting. In many cases two or more adhesives should be considered. Sample bonds should then be made and exposed to actual or simulated service conditions, and tested to determine actual bond strengths.

Parts to be bonded should be designed to take fullest advantage of the desired properties in selected adhesives. Adhesives seldom display their best properties when substituted directly for other fastenings. In the final selection of an adhesive, the engineer must consider end product properties, materials costs, labor, capital expenditures for jigs and bonding equipment, and other factors which may affect the production and sale of products.

Long term life experience with adhesives under severe load bearing requirements is available in the aircraft industry, where applicable adhesives have basic advantages over fusion and mechanical methods of joining. They can be used by simple and practical methods. In short, structural adhesives are another engineering tool . . . a tool to be considered by all design engineers for joining metal or structural plastics.

To be continued in the March issue of Design Engineering.

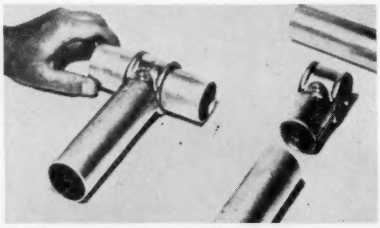


Figure 5 — Modern pipe and fitting assemblies are easily handled with chemical adhesives.

Where's the engine they said someone else had invented?

Dear Sir,

Several months ago, Time Magazine and the Reader's Digest published a description of the revolutionary Wenkel engine being developed in Germany.

In 1944, while in training in the Air Force, as I was trying to improve on the theory of a rotating piston engine I had patented in 1941, I discovered, or rediscovered, a peculiar pump profile of the cycloid family which could be readily adapted to an engine theory.

I forgot all about it until 1947, when I sent a rough sketch to the National Inventor Council in Washington asking for their opinion. I received the reply that the pump had been known for a while and was in use. I didn't worry any more about it.

After 13 years, with my memory refreshed by the Wenkel engine, I am wondering why I never saw anywhere models or even sketches of my pump-engine.

The engine is divided in two groups of chambers with associated rotors, the first group for compression, the second for explosion and expansion. The valve action is performed by the rotors themselves uncovering vents in the separating wall through which the compressed gases are transferred to the explosion chambers. The two sets of rotors are synchronized by "backlashless" gears which is one of the biggest flaws of the theory. Sealings are another. This particular model is equivalent to an eight cylinder engine.

If the Wenkel engine works, I don't see why this shouldn't.

A. L. Perrin

Agincourt, Ont.

Quebec group is an official committee

Dear Sir,

Both your September editorial dealing with provincial associations and the letter in October from a member of the Committee for the Advancement of the Employee Engineer quote some erroneous information released to some engineering circles in Ontario. The following extract from your September editorial illustrates what I am referring to:

"In Quebec toward the end of 1959 a Committee for the Advancement of the Employee Engineer was formed among the professional engineers of that province. This committee sponsored contestants for two of the council positions in the 1960 annual elections, and both were elected with good majorities."

I would like to make two points with respect to this statement:

1. The "Committee on the Advancement of the Employee Engineer" was the name used last year to designate an official Corporation Committee. This Committee did not participate in any way in the election of Council. An informal group of members did however campaign actively in favor of two of the councillors who were elected last year.

2. The Corporation's Committee on the Advancement of the Employee Engineer bears no resemblance to the Ontario Committee on the Advancement of Professional Engineering (CAPE). Our Committee's origins go back to a Committee on the Young Engineer, of which I had the pleasure of being the secretary some ten years ago. Eventually this committee became known as the Committee on the Advancement of the Employee Engineer. Last year, however, its name was simplified to Committee on the Employee Engineer.

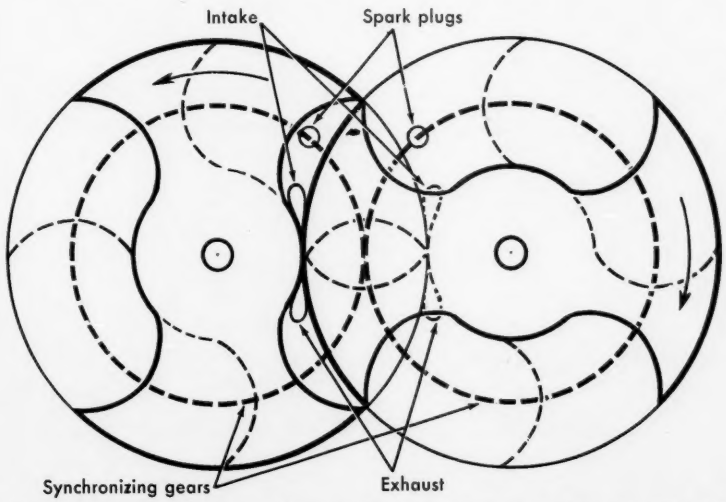
It has accomplished remarkable work in providing assistance to employee engineers as well as to employers in their efforts to establish a climate conducive to full professional growth of the engineer.

This has been possible because of the professional attitude which has developed amongst salaried engineers with the co-operation of the Corporation's Council, committees and staff. At the same time, management has become impressed with the importance of granting proper recognition to its professional employees.

To help engineers and their employers, the Corporation has made available an excellent booklet entitled "Criteria for the Professional Employment of Engineers". It is available on request from the Corporation.

W. J. Riley, P.Eng.
Immediate past-president
Corporation of Professional Engineers of Quebec

(Thanks for your comments. We apologize for falling into a trap over the activities of your Employees Engineer Committee. From our observation, Quebec appears to be leading the parade when it comes to employee engineer interests.—Editor.)



The compression rotors are shown in the dotted lines and shifted by 45° with respect to the "detente" rotors. Intake, transfer and exhaust vents are situated in three different planes.

People . . .
. . . and events

Tabloid promotes exports

An international trade newspaper has been launched by the Department of Trade and Commerce to promote Canada and her industries, products and services to foreign buyers. The tabloid size newspaper, Canada Courier, will be distributed from Canada's 63 trade offices abroad to importers, agents, manufacturers, engineers, bankers, government officials, etc.

The first issue, dated January 1961, carries stories on a Montreal firm's $18 million electronics order abroad; a new Canadian process to roll cobalt strip direct from metallic powders; the Canadian unveiling of the first uranium alloy steel and practical powder metallurgy at a recent Philadelphia exposition; and the current export drive.

Stelco leads with metrics

For the first time a North American manufacturer is supplying bolts and nuts produced to the international metric system. The Steel Co. of Canada Ltd. introduced the service to meet the growing demand for metric threaded fasteners.

The company reports that the demand comes not only from countries where the metric system is standard, but also from North American firms servicing European machinery and automobiles and from firms which are exporting industrial equipment to Europe.

Union Carbide grants

Union Carbide Canada Ltd. will this year award scholarships worth $30,000 to 60 students attending Canadian universities. Each will receive $500 a year until his undergraduate studies are completed.

Thirty-five of the 60 scholarships are renewals and the remaining 25 are new or replacement awards. Nineteen universities participate in the program. In addition to these scholarships, the company awards four $1,500 a year postgraduate research fellowships, two each at McGill and the University of Toronto.

The program has been in existence since 1954 and has assisted over 200 students at a cost of nearly half a million dollars, including capital grants to university building funds.

Readies emulsions plant

Borden Chemical Co. (Canada) Ltd. is erecting manufacturing facilities for the production of polyvinyl acetate emulsions, polystyrene and acrylic emulsions, and liquid urea resins. The $1¼ million plant in West Hill, Ont., will be completed this year.

Chief markets for the new resins and emulsions are the adhesives, plywood, paint and particle board industries. The entire output will be for Canadian consumption.

New name and address

Tatnall Measuring & Nuclear Systems Ltd. has changed its name to Budd Instruments Ltd. The change shows the link with the instruments division of the Budd Company in the U.S.

Another change is that the company has moved to new offices at 170 Donway West, Don Mills, Ont.

In brief

Patterson Foundry & Machine Co. (Canada) Ltd. has been re-acquired by its former parent, Patterson Foundry & Machine Co., East Liverpool, Ohio. Both companies manufacture machinery for chemical, paint, plastic and related industries.

Ford Motor Co. of Canada Ltd. has entered the diesel field with a new line of tilt-cab diesel-powered tractors.

Canadian Broomwade Ltd., specialists in the manufacture and distribution of compressed air and allied equipment, are building a 40,000 sq. ft. plant near Toronto.

Rex Chainbelt (Canada) Ltd. has raised the Montreal and Toronto industrial sales offices to the status of branches instead of sections of other departments. Martin J. Warren is manager in Toronto and Harry J. Wilson in Montreal.

Freezmart Co. Ltd., Toronto designers, engineers and contractors, have moved to larger premises at 530 King Street East.

A polyurethane rigid foam technical service laboratory has been established in Toronto by the chemicals division of Canadian Industries Ltd. The laboratory offers services for the application of techniques for foaming-in-place by both spraying and pouring.

Personalities

George McKinstry Dick, P.Eng., MEIC, president of the Engineering Institute of Canada and chief engineer of Canadian Ingersoll-Rand Co. Ltd., recently received an honorary degree of D.Sc. at the University of Sherbrooke, one of the newer educational institutions in Canada.

Saskatchewan born Dr. Earle S. Ebers has been named group executive vice-president of United States Rubber Co. in charge of all polymer, fiber and chemical operations.

Appointments

Dr. J. F. Perrier, P.Eng. has been named engineering department head for systems at Sperry Gyroscope Co. of Canada Ltd.

Perrier

McAdam

Frederick L. McAdam, P.Eng., has been appointed chief engineer of Marshall Macklin Monaghan Ltd., consulting professional engineers and town planners.

J. Hector LeBlanc has been elevated to president of Freezmart Co. Ltd., designers, engineers and contractors. He will continue to manage the packaging-house design division. Bertrand England moves up from senior sales engineer to vice-president in charge of engineering, development and design.

M. Bruce Mairs, P.Eng., has been named assistant general manager, Canadian operations, H. K. Porter Co. (Canada) Ltd.

For your calendar

January 13: Canadian Welding Society, Montreal chapter, seminar on codes and specifications, L'Ecole Polytechnique, Montreal.

February 14-16: Society for Nondestructive Testing, annual seminar on nondestructive testing of aircraft and missile components, Gunter Hotel, San Antonio, Texas.

March 6-8: National Heating and Air Conditioning Show, Toronto.

April 4-6: National Microfilm Association, annual meeting and convention, Sherman Hotel, Chicago.

April 10-21: American Welding Society, annual convention and welding exposition, Sheraton-Atlantic Hotel, New York.

May 17-19: Society for Nondestructive Testing, regional convention, Mount Royal Hotel, Montreal.

May 22-25: Design Engineering Show and annual convention of American Society of Mechanical Engineers, Cobo Hall, Detroit.

May 30-June 2: Engineering Institute of Canada, annual meeting, Vancouver.

June 5-9: Plastics Exposition, Coliseum, New York.

Technical literature

Glass-metal components — Bulletin on a complete line of glass and glass-metal components, vacuum measuring instruments, etc. Fredericks Co.

Circle 307 on Reader Service Card

Tooling balls — Bulletin giving applications and specifications of hardened stainless steel tooling balls for making and checking jigs, fixtures and machine setups. Industrial Tectonics Inc.

Circle 308 on Reader Service Card

Zinc anodes — Specification brochure on Cominco zinc anodes, especially prepared for designers of equipment in contact with brines or sea water. Consolidated Mining & Smelting Co. of Canada Ltd.

Circle 309 on Reader Service Card

Industrial trucks — Brochure for materials handling engineers on proper truck selection, with case histories showing how the wrong truck can cause unproductive output and increase costs. Automatic Transportation Co.

Circle 310 on Reader Service Card

Industrial band clamps — 44-page catalogue containing product information on band clamps, hose clamps, couplings, flanges and V-band joints. Aeroquip Corp.

Circle 311 on Reader Service Card

Wire forming machines — Eight-page catalogue giving engineering features on a range of automatic high-speed ribbon and wire forming machines. Baird Machine Co.

Circle 312 on Reader Service Card

Sound systems — Booklet announcing a new sound system service for every field, including industry, religion, etc. Philips Electronics Industries Ltd.

Circle 313 on Reader Service Card

Buffing and polishing speed calculator —Pocket-sized calculator for determining the surface speed of buffing and polishing wheels. Hanson-Van Winkle-Munning Co.

Circle 314 on Reader Service Card

Filter-drier — Bulletin listing the advantages of a new type in porous block construction for refrigerant systems. Davis Automatic Controls Ltd.

Circle 315 on Reader Service Card

Gear inspection machines — Brochure on a new range of models, including a precision involute profile checking machine designed for checking gear shaving cutters. National Broach & Machine Co.

Circle 316 on Reader Service Card

Technical literature *continued*

Inco metals — Booklet describing how the Inco family of two (nickel and copper) grew to 14. International Nickel Co. of Canada Ltd.

Circle 317 on Reader Service Card

Urethane foams — 24-page fact file on the industrial and commercial applications for urethane foams, with property and performance data, review of their future scope, etc. Mobay Chemical Co.

Circle 318 on Reader Service Card

Underfloor wiring systems — Bulletin describing three systems — standard duct, big duct and two-level duct. Canadian General Electric Co. Ltd.

Circle 319 on Reader Service Card

Self-bonding nameplates — Bulletin explaining a new type of nameplate that both identifies the product and serves a decorative function. W. H. Brady Co. of Canada Ltd.

Circle 320 on Reader Service Card

Direct-writing recorders — Brochure describing electric and ink writing types for recording electrical and physical phenomena in research, production, etc. Bayley Engineering Ltd.

Circle 321 on Reader Service Card

Seals — 12-page catalogue describing a new design in hydraulic seals. Bestobell (Canada) Ltd.

Circle 322 on Reader Service Card

Spiral spacer — Brochure on a new universal-type spacer for use in joining crushable panels, tubing, etc., to other parts. Huck Mfg. Co.

Circle 323 on Reader Service Card

Couplings — Brochure on quick-disconnect couplings, nipples and hose fittings for pneumatic and hydraulic uses. J. B. Morrison Machinery Co. Ltd.

Circle 324 on Reader Service Card

Single crystals — Bulletins on single crystals of refractory materials, including tungsten, molybdenum, vanadium, etc. Union Carbide Canada Ltd.

Circle 325 on Reader Service Card

Tank contents gauges—Brochure describing a range of gauges, controllers, indicators, etc. Bestobell (Canada) Ltd.

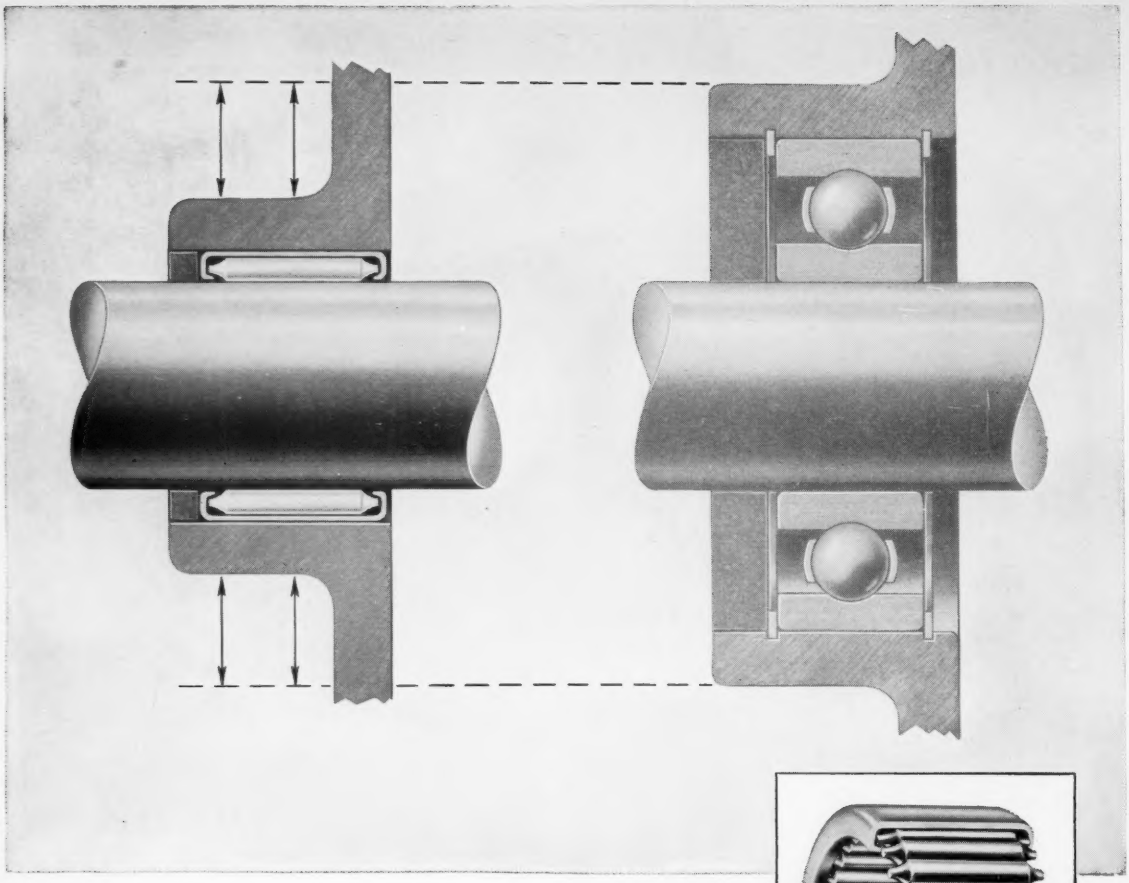
Circle 326 on Reader Service Card

Plastic lenses—Bulletin on low-cost, lightweight, optically ground plastic lenses for projectors, magnifiers, light dispersers, etc. Fostoria Corp.

Circle 327 on Reader Service Card

Bevelling machine—Brochure on a new machine which is said to cut bevel cutting costs by 85%. Pullman Canada Ltd.

Circle 328 on Reader Service Card



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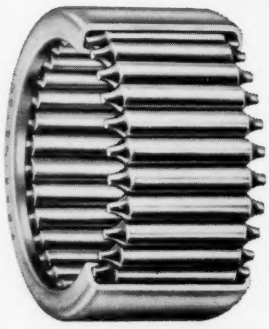

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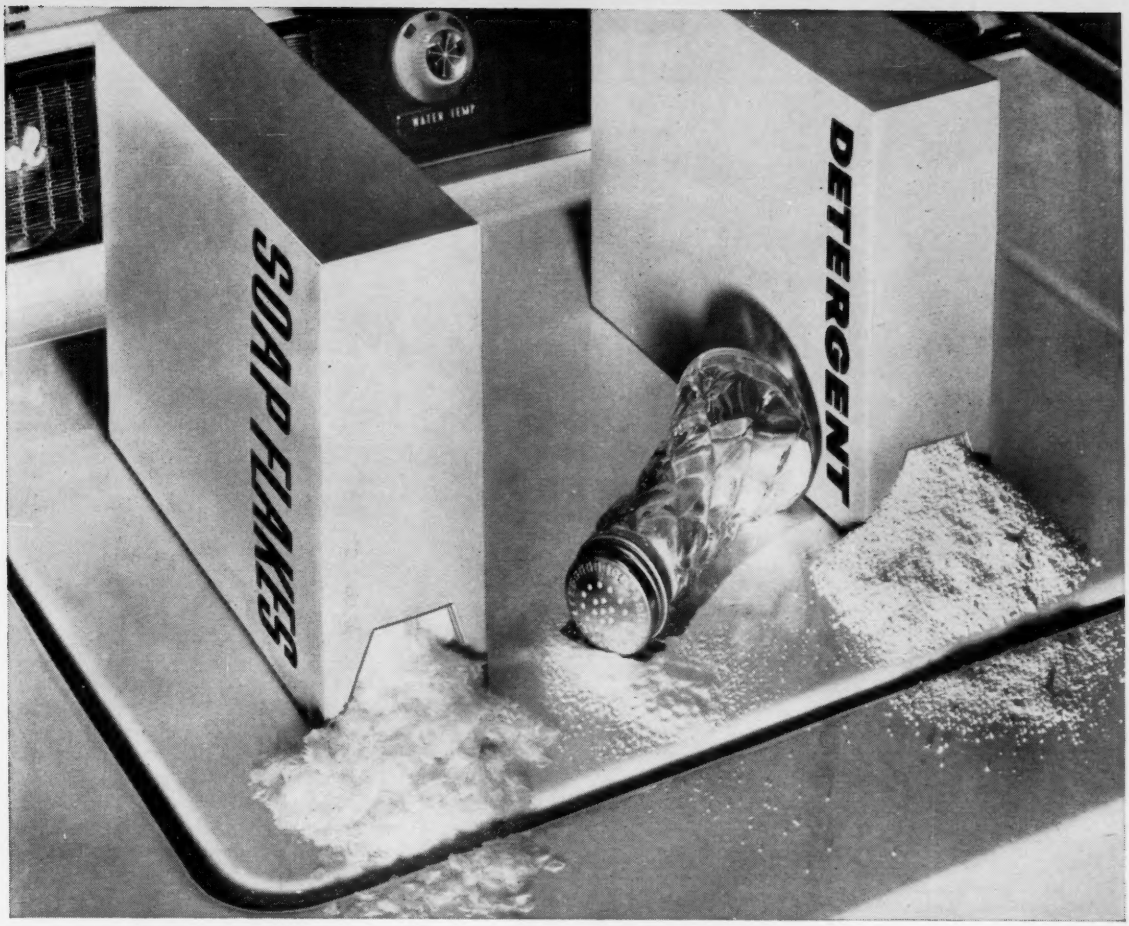

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The features of hysteresis motors are combined with the price of a standard two or four pole shaded motor in a new synchronous motor suited to driving phonographs, tape recorders and similar mechanisms. The permanent magnetization of both ends of an induction motor gives the rotor a combination of synchronous and induction torque. The motor thus locks permanently into synchronous speed and is free from slip. Alliance Mfg. Co.

Circle 330 on Reader Service Card

Asbestos-insulated cable

Asbestos-insulated cable used in electrical appliances has been noted for its inadequate abrasion resistance and its tendency to open up when bent. Some manufacturers tried to overcome these problems by using an outer covering of treated glass braid, but this does little to solve the problem of abrasion resistance, though it will prevent the cable from opening up. Now a new construction of type A-16 (A) cable is said to overcome both problems by using asbestos braid. H. K. Porter Co. (Canada) Ltd.

Circle 331 on Reader Service Card

Vulcanized fibre

Improved dielectric strength and arc resistance are claimed for a new electrical grade of flame-resistant vulcanized rubber. It is intended for use as combination flame, heat and dielectric barrier in electrical and electronic equipment. Applications include data processing equipment, business machines, radios, television sets and appliances.
National Fibre Co. of Canada Ltd.

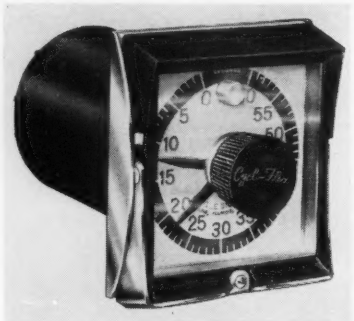
Circle 332 on Reader Service Card

Transmitting rotameter

An instrument has been developed which combines the functions of an indicating rotameter and a pneumatic transmitter. It measures liquid or gas flows and can be used with any metering tube ½ in to 2 in. in diameter covering flow equivalent to 1 to 100 gpm water and 4 to 400 scfm air. Fischer & Porter (Canada) Ltd.

Circle 333 on Reader Service Card

Reset timer



A new reset timer has a plug-in feature for quick installation, quick change of time range and a quick means of localizing trouble. The instrument is designed for industrial control applications such as conveyor control and induction heating equipment. It is rated at 10 amp. 115 volts and at 5 amp 230 volts resistive load, for 50 or 60 cycle service. Davis Automatic Controls Ltd.

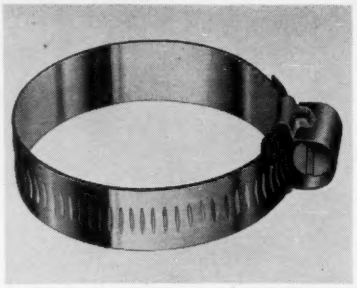
Circle 334 on Reader Service Card

Seal fitting

A long-sought answer to critical fluid handling problems is a metal sealing ring for use on straight thread fittings where a conventional synthetic rubber o-ring with back-up washer is not acceptable. The sealing ring is designed to work in the standard SAE o-ring fitting boss, providing a metal-to-metal seating for a highly satisfactory seal. It is installed in the straight thread boss in the normal manner and can be used repeatedly without damage to itself or the boss. Parker-Hannifin Corp.

Circle 335 on Reader Service Card

Hose clamp



Unlike old-style worm-drive type clamps, a newly developed hose clamp has no perforations through the band to cause extrusion or scuffing of rubber. The steel screw engages on coined threads. The clamp is easily removed, provides uniform clamping pressure and will not distort thin wall tubing. Wide diameter adjustment is possible because of a high strength band, and another unusual feature is the band take-up, which is directed away from the fastening side of the housing to eliminate interference during assembly. Aeroquip (Canada) Ltd.

Circle 336 on Reader Service Card

Ball valves

A line of top-entry ball valves has been redesigned with socket weld connections to permit the valve body to be permanently welded into the pipeline. Access to the valve parts is provided by a removable bonnet and stem assembly. Hills-McCanna Co.

Circle 337 on Reader Service Card

Air impulse counter

A new air impulse counter greatly simplifies the counting of all air-actuated machine operations. There are no brackets, levers or springs to wear out, and the absence of electric contacts makes it ideal for humid and explosive atmospheres. The counter is actuated by impulses as low as 15 psi and will register up to 100,000. L. J. Bardwell Co.

Circle 338 on Reader Service Card

Printed circuit flux

Even metal surfaces normally resistant to fluxing can now be soldered with a new printed circuit flux. Used for electrical equipment parts, it works well with a variety of metals including brass, bronze, cadmium plate and copper. It is applied by dipping, brushing or spraying. Alpha Metals Inc.

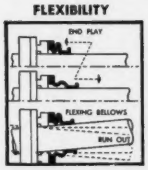
Circle 339 on Reader Service Card

(Continued on page 56)

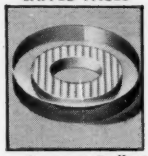
Shaft Seal Design With A Purpose!

POSITIVE DRIVE

FLEXIBILITY



PRECISION MATED LAPPED FACES



POSITIVE DRIVE provides long seal life. Driving band and washer driving notch absorb breakout and running torque. Damaging stresses on flexible sealing member are eliminated. Shaft and sleeve are protected against galling.

FLEXIBILITY eliminates axial and radial misalignment. Self-adjusting sealing head compensates for end play or run out. Maximum spring pressure is required for axial shaft movement . . . minimum spring pressure is maintained during radial shaft movement

PRECISION MANUFACTURE assures leakproof performance. Washer and seat surfaces are lapped to a perfect mate.

A SEAL FOR EVERY SERVICE . . . from water to destructive acids, corrosives and gases . . . temperatures to 1000°F. . . . pressures to 1200 psi . . . types and sizes to fit practically any mechanical or dimensional condition.

Request Bulletin S-204-2

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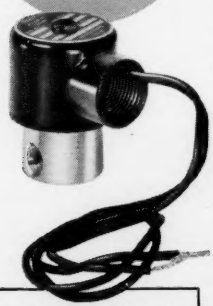
For further information mark No. 111 on Readers' Service Card

New...from MARSH!

Small solenoid valves that fill a BIG order

MARSH *Master-mite* SOLENOID VALVES



Conduit-type Master-mite. Grommet-type also available.

Designed to meet the need for positive-acting tight-seating valves for use on wide variety of media, including oxygen, hydrogen, acetylene, etc.

Two Types:
Conduit type and grommet type. Port sizes 1/8" and 1/4" NPT.

Ten orifice sizes:
3/64" through 1/4".

Wide range of voltages:
Standard with 115 V. A. C. but also available in 12, 24, 208, 230, 460 V. A.C.

Pressure to 540 psi.

Small, but with more strength in the Marsh manner. Coils never overheat. Entire assembly leak tight. Remarkably quiet operation. Cleanable without breaking connections. Used in any position. Bodies either brass bar stock or 18-8 stainless steel. All moving parts stainless. Underwriters' approved for use on oxygen and hydrogen and as safety valves.

Write for new bulletin

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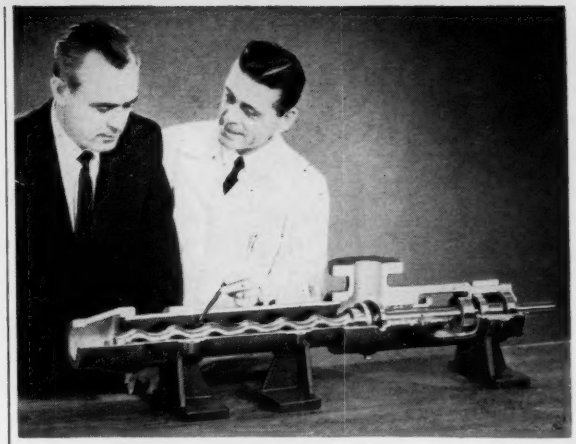
Dept. 46 Skokie, Illinois
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Canada, Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas.

For further information mark No. 124 on Readers' Service Card

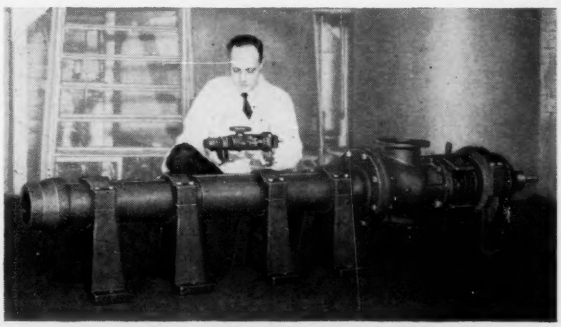


Let MOYNO'S "*Progressing Cavities*" Cut your Pump Maintenance Costs!

MOYNO's unique *"progressing cavity"* principle cuts pump maintenance costs because material being moved contacts only one moving element. MOYNOS are constructed to stoutly resist corrosion and abrasion. As shown in the cutaway model above, MOYNO'S screw-like rotor revolves in a double-threaded stator forming *"progressing cavities"* that move material smoothly along, without foaming, aerating or crushing. Even where duty is so torturous that rotor must be made of special resistant materials, MOYNO parts show little wear.

In industry everywhere, and on OEM applications, MOYNOS are proving "if it can be pushed through a pipe . . . MOYNO will pump it!" Typical materials pumped include non-pourable pastes, abrasives, slurries, chemicals, foods, acids, even suspended solids up to one inch in size. Many materials now successfully pumped by MOYNO were once considered "unpumpable" . . . had run up prohibitive maintenance costs on other type pumps or ruined them completely.

Capacities are available up to 500 gpm and pressures up to 1000 psi. Off-the-shelf replacement parts are always immediately available. No doubt your plant flowsheet or OEM product has a spot where MOYNOS can cut costs drastically. To find out how, write today for Bulletin 30-C!



capacities to 500 gpm; pressures to 1000 psi

THE ROBBINS & MYERS COMPANY
of CANADA LIMITED—BRANTFORD, ONTARIO

For further information mark No. 132 on Readers' Service Card

New products and materials *Continued*

Lubricant coating

Said to be easier to apply than phosphating or many resin-bonded coatings a new bonded lubricant coating requires neither chemical nor mechanical surface pre-treatment such as sand-blasting or oven curing. It was designed to increase cutting tool life, but is also suitable for heavily loaded ferrous bearing surfaces. Dow Corning Silicones Ltd.

Circle 340 on Reader Service Card

Visible drain

A new type of drain for attachment to air tanks, air lines, etc., is equipped with a transparent bowl with a drain cock in the bottom, thus providing a visible sump which can be manually drained. The drain has no mechanism to foul and requires only one connection. Rousseau Controls Ltd.

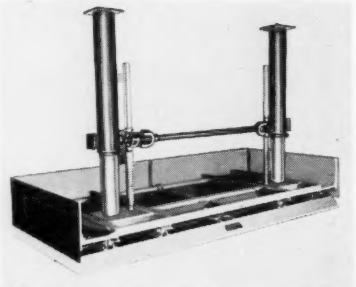
Circle 341 on Reader Service Card

Amplifier

A new chopper-stabilized dc amplifier is said to have 2.5 times as much power output and five times as much voltage output as previous models in its line. It can step up low-level signals from a variety of transducers to 10 volts. Known as the AccuData III, it is described as particularly useful in high-frequency data handling systems because it minimizes the pick-up problems associated with long cable runs and ground loops. Honeywell Controls Ltd.

Circle 342 on Reader Service Card

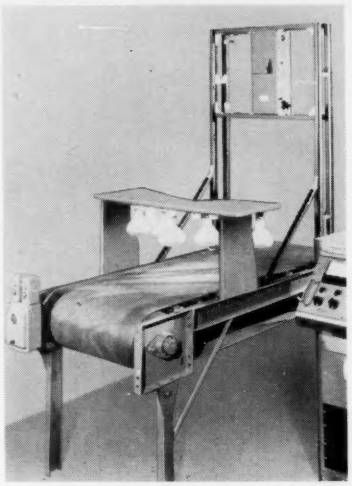
Lift platform



A new type of multiple-post hydraulic lift platform remains level within one-twelfth of a degree. Two or more hydraulic rams in an equally proportioned geometrical arrangement can be used, all rams being fed by a common hydraulic pressure source and mechanically coupled by a rack and pinion equalizing system. Any motion in a ram must be matched by motion in all others, which compensates for any slight pressure differences, frictional irregularities, etc. Canada Crane & Hoist Co.

Circle 343 on Reader Service Card

Inspection system



Adaptable to a great variety of processes in the plastics, metals, glass, food processing and textile fields is a new low-cost light sensing electronic inspection system for separating imperfect items from conveyor lines. The equipment can detect imperfections that create only 3% variation in light from the items being inspected. Typical applications include detecting flaws in sheet metal or plastic, removing discolored food products and marking faulty weaving in textile products. Atronic Products Inc.

Circle 344 on Reader Service Card

Circuit board

A new device simplifies the assembly of components in circuits. A low-cost, pre-etched circuit board, it is designed to accommodate almost any circuit configuration encountered in transistor and similar circuit design. It makes the construction of an unlimited number of circuits simple and inexpensive as all components, including the circuit board itself, can be used repeatedly. L. J. Bardwell Co.

Circle 345 on Reader Service Card

Strain gauge

A new bending-separator gauge will separate and identify tensile strains and strains produced by bending moments on the surface of a structure. Its main feature is that it can be mounted on one side of a structure only, thus eliminating the need for mounting strain gauges back to back both inside and outside such structures as pressure vessels. Budd Instruments Ltd.

Circle 346 on Reader Service Card

Design Centre to be attuned to industry

Watch for a move by the Industrial Design Division of the National Gallery, and its affiliate, the Design Centre, from the Department of Immigration to the Department of Trade and Commerce.

The move will bring the Design Centre closer to the world of manufacturing and business. The new director, when he is appointed, is expected to be a man closely identified with industrial production.

The Design Centre was formed in 1948 to promote good design in Canada. It conducts a scholarship program for industrial designers, disseminates information on design to industry and stages exhibitions in Ottawa and across the country.

Meanwhile Norman M. Hay, former director of the National Industrial Design Council, which operates the Design Centre, is now with Robin Bush & Associates, Toronto, as a design consultant.

Minister of Industry?

The recent appointment of Ernest Halfpenny as Minister without Portfolio is seen in the capital as the first cabinet representation for Canada's manufacturing interests. Observers link the appointment with the recent request by the Canadian Manufacturers' Association for cabinet representation on a level with agriculture, mining, fishing and forestry.

Mr. Halfpenny, a manufacturing chemist and until recently owner of a pharmaceutical company, may initially act as liaison between industry and Trade Minister George Hees as well as between industry and the government as a whole. Eventually he may take charge of the assorted crown corporations and agencies. Some of these, such as the National Film Board, the National Gallery, the CBC and so on, are scattered haphazardly among various departments.

That's not cricket

North American indoor bowling has invaded Britain. Drawing attention to this phenomenon, the government publication Foreign Trade says Canadian sports goods manufacturers should have a crack at this lucrative market. It believes there are also openings over there for the following:

Outboard motors; small boats, marine hardware; fishing tackle; golf clubs; camping equipment; tents; fishing and hunting clothes; roller skates, ice skates; archery equipment; sporting firearms and playground equipment.

The report, by W. Gibson-Smith, Commercial Secretary in London, notes that all import restrictions on such goods have been lifted. On top of that Canadian products get British Preferential tariff rates, giving them an advantage over competitors from Europe or the United States.

For further information check with P. Grant Jones, Commodities Branch, Trade Department, Ottawa or Gibson-Smith at Canada House, London.

Export outlook: sunny

An unexpected boom in trade could mean that Canada finished 1960 with its first favorable trade balance for eight years. The excess of imports over exports was only $120 million for the first nine months of the year, compared with $416 million for the same period in 1959. Since exports traditionally exceed imports for the final three months of the year, a favorable balance is a distinct possibility for 1960.

The surplus, if any, would be on commodity trade alone. A heavy deficit of over a billion dollars is expected on invisible trade such as tourism, freight, insurance and repayment of interest on foreign investments.

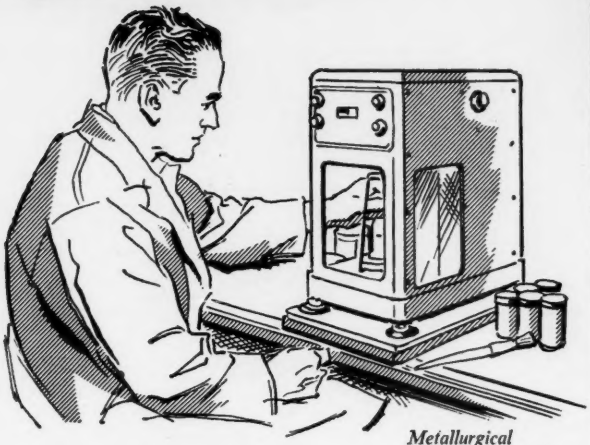
Domestic outlook: cloudy

A cloudy outlook for the manufacture and sale of durable goods emerges from the pages of the government's mid-year survey of the gross national product.

In summary, consumers are spending less on durables, manufacturers are producing less but building up larger inventories, and retailers are scaling down their stocks.

Among individual industries iron castings, gypsum products and telecommunications equipment all showed a loss of output in the second quarter of over 20%. Concrete products dropped 15% and primary iron and steel by 14%. Other industries to fare worse than the average decline for durable manufacturers as a whole were agricultural implements, heating and cooking apparatus, refrigerators and appliances, autos, auto parts and wire and wire goods.

PASSED!



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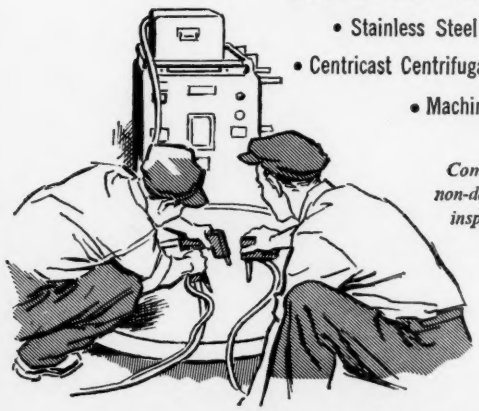

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Hartford's Vers-O-Line is constantly expanding to meet the demand of value analysts for one economical unit to replace several more costly integral parts. Instead of specifying more costly precision bearings explore the possibilities of Vers-O-Line. Hartford engineers can help your design engineers by recommending or adapting a bearing from a wide variety available in stock or can imagineer a new design to meet your product specification that can be produced to effect substantial savings. Types of Hartford bearings in Vers-O-Line include:

RADIAL . . *H-Series*
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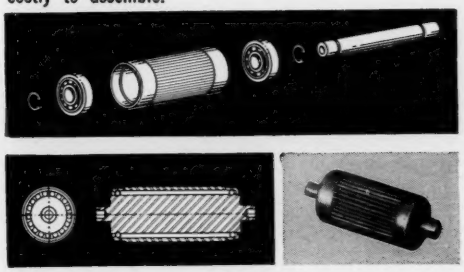
THRUST
VERSA-TWIN . . *Twin Row*

TYPICAL EXAMPLE

Before—Six separate parts, expensive bearings and costly to assemble.



After—One complete economical assembly, reduced parts, maximum stability.

Write for comprehensive technical literature containing case history applications and helpful bearing ideas.

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Hartford Steel Ball Company, 102 Jefferson Ave., West Hartford, Conn.

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Briefs

Gadgetry continues to flourish all over the world. **A Swiss** inventor has produced a cigaret case with a built-in time lock for the man who wants to cut down on his smoking . . . **In Germany** an alarm clock wakens its victim with an electric shock . . . **Japan's latest** transistor radio is built right into the frame of a pair of sunglasses . . . **A doll** produced in the U.S. acquires a tan when placed in the sun, loses it in the shade . . . **And in** England a self-lighting cigaret, that hardy perennial, at last appears to be a reality . . .

Nearer home, **a Vancouver** machinist has invented a beer dispensing machine for the patron who fears that the bartender is giving him a short drink . . . **A Toronto** mechanic claims an invention that eliminates carbon monoxide and other polluting gases . . . **And a Sault Ste. Marie,** Ont., millworker has come up with a self-lubricating skate that puts more speed into hockey . . .

You'll want to know what success these inventors have had. There's no information about any of the overseas products except the self-lighting cigaret. A company has been formed to exploit the world market and will license one manufacturer in each country. The local inventions are enjoying varying success. **The Vancouver** beer pouring machine hasn't won approval from the president of the B.C. Hotel Association, but at least one hotel manager plans to buy it . . . **The Toronto** inventor of the machine to end pollution has spent five years on it with as yet no financial return . . . **The Sault Ste. Marie** steel worker who designed a new hockey skate has been turned down by the Toronto Maple Leafs and made no progress with the NHL . . . The inventor's lot is not a happy one.

But here's an invention with an assured market. It's a mechanical teacher and it costs only $20. Launched by a New York book publishing firm, it operates by exposing the student to one small piece of information at a time. It checks his understanding of the subject by requiring him to answer a question and tells him whether he's right or wrong.

Short takes: **New York** developer is putting up a 28-storey apartment building overlooking the Hudson; for tenants at the back there'll be closed circuit TV showing the river . . . **A book** just published by the University of Illinois engineering department proposes a new science, Zetetics, the science of research . . . **A Toledo** electrochemist says fuel cells for automobiles are still in the dream category . . . **Canadian Standards** Association has now followed the American Standards Association in renaming type Z tapping screws type B . . . **Nitrogen was** recently used to purge a new 4,750 yard long and 24 in. diameter steel gas main in the United Kingdom . . . **English furniture** manufacturer has developed two successful export ideas — garden furniture shipped in knock-down state and cocktail bars made from old barrels, complete with castors and brass hoops . . . **The Bituminous** Coal Institute of Canada reports a growing Canadian and U.S. trend to "district heating," meaning a central heating plant that supplies neighboring factories, shopping plazas, apartment blocks, schools, churches, etc. . . . be sure you read Backlash this month . . .

Talepiece: Being in the business of communications ourselves, we feel deeply for the secretariat of the Association of Professional Engineers of Manitoba. Seems they sent out a mailing to the membership calling for information for the roster. Only 50% of the cards were correct. The commonest error was to list names as "Smith, A. Q." instead of the required "Algernon Quincey Smith." A second mailing was sent out with a careful explanation that initials don't constitute a full name, etc. This time 52.4% of the cards were correct! . . .

Designers' book shelf

Alternating Current Machines, by H. Cotton, MBE, DSc, MIEE, Emeritus Professor of Electrical Engineering at University of Nottingham. Publisher —Cleaver-Hume Press, London, England. 325 pages. Price 21s.

An interestingly illustrated and highly readable book dealing with the commonest kinds of electrical machinery. The treatment is virtually non-mathematical, therefore has excellent appeal for those in industry.

Circle 347 on Reader Service Card

Nuclear Engineering Monographs, by B. T. Frost and M. B. Waldron. Publisher—Temple Press, London,, England. 80 pages. Price 12s 6d.

Understanding the properties of materials which they will be called upon to use is one of the major problems facing the new breed of nuclear engineers. This little handbook seeks to resolve that problem. The general properties of the nuclear metals, from beryllium to uranium, structural steels, graphite and ceramics are discussed in their relation to reactor engineering.

Circle 348 on Reader Service Card

Advanced Dynamics for Engineers by G. M. Smith and G. L. Downey, Professors at University of Nebraska. Published by International Textbook Company, Scranton, Pa. 360 pages. Price $12.00.

An advanced presentation in engineering dynamics intended for those who have some knowledge of basic dynamics. Emphasis is placed on the derivation and solution of differential equations of motion. Vector analysis is used as a rigorous and efficient method of analysis. An excellent guide for those involved in advanced dynamics.

Circle 349 on Reader Service Card

The Control of Multivariable Systems, by Mihaljo D. Mesarovic, professor, Case Institute of Technology. Published by John Wiley & Sons, New York. 110 pages. Price $3.50.

This book suggests that future theory about control systems should rest on a multivariable, rather than single-variable, foundation. Asserting that interaction and uncertainty are the main properties of multivariable control systems, the book recommends specific control structural patterns.

Circle 350 on Reader Service Card

backlash

Our new look

If you did not immediately recognize this copy of DE from the front cover, don't feel badly — you will probably not be the only reader to have to look twice.

Publishing a magazine is, in many ways, like designing or engineering any other product. The editors are always on the lookout for means of improving their product.

With this issue DE moves into a new phase. You will have sensed it in the cover; you will also sense it primarily in the new format. But this is no mere surface restyling.

In its formative years DE set the pace for straight functional presentation. Its functional covers were recognized from coast to coast. The elements in its pages were arranged in neat compartments — each box had a neatly ruled frame — each section was neatly labelled. That format did an excellent job, in fact it influenced many other publications in their page and cover arrangements.

But times change and the old design philosophies atrophy. DE's design philosophy, both in editorial policy and outward appearance has grown and changed too. So you will note in the new format a greater freedom as the old straight formal approach has been discarded; there will be more room for you to think; and we trust you will sense a greater degree of stimulation as you scan our 'new look'.

Could you answer?

Were you among those we invited to express their views on this month's opinion poll? If not, you are possibly in the minority. But could you have answered the question, which reads: "Should provincial engineering associations allow time at their annual meetings for discussion and motions from the floor?"

You may find this hard to believe, but we asked hundreds of professional engineers in Canada to give us their opinions. All we got in return was a fantastic variety of excuses for declining. The real reason, we suspect in most cases, was that the engineer questioned had never attended an annual meeting and therefore had no idea of whether his own association permitted such discussion or no.

After getting only one answer from three large mailings to our readers, we began to call them on the telephone one by one. Meanwhile, our correspondents in Ottawa, Montreal, Winnipeg and Vancouver were doing the same thing. The net result — a couple more answers, but mostly evasions.

One man said, "It's my understanding that participating members from the audience can always make motions or proposals, and it couldn't be otherwise." (This is so only in Quebec, so far as we know). Other answers: "I couldn't contribute anything worthwhile"; "Not interested in the association"; "I'm not that close to association affairs."

Now we suggest you turn back and read what actually was said on this important matter by three engineers who do have an interest in the welfare of their profession. The right of free speech in provincial association business should not be treated lightly by any member.

The lion's share

Seventy-seven percent of the direct research support contributed by the National Research Council to Canadian universities in 1959-60 went to engineering and science research, the balance to medical research.

NRC contributed a record $9,370,000 during the year, an increase of $2,620,000 over 1958-59, of which direct research support amounted to $5,580,000. Biggest single item was $7,260,000 for research grants to university staff members, while another $1,320,000 financed more than 450 scholarships and fellowships. Indirect research included the cost of publishing scientific journals and contributing to scientific organizations and conferences.

All about hydraulics

Nineteen engineers from Europe, Canada and U. S. attended the electro-hydraulics servomechanism course sponsored in November by Vickers Incorporated of Detroit, Michigan. The course lasted one week, and covered the design, application and maintenance of the many different components which make up servosystems.

The courses conducted by Vickers Hydraulic School cover all phases of fluid power engineering, from basic principles to the most advanced concepts. They run from one day to two weeks in duration, and are offered without fee or other charge to engineers meeting the

Ron Render, Staff Supervisor, Electro-Hydraulics, Vickers Inc., explains the building block system of servos, as Doug Kaill of DE and Peter Chupac of Ford Motor Company in Detroit look on.

(Continued on page 64)

backlash

(Continued from page 62)

entrance requirements. Canadians are more than welcome. Equipment and materials for the courses are also provided free, the student engineer furnishing only transportation to Detroit and living expenses.

DE's editor Doug Kaill was one of the nineteen who took the recent servo course, and he reports that the instruction program was excellent. He highly recommends the courses for all those who desire basic training in hydraulics.

Complete details may be had by writing to Vickers-Sperry of Canada Limited, 92 Advance Road, Toronto.

All eyes on Ontario

Ontario's budding engineering technician organization (see page 38) has some surprises in store for those who are interested enough to investigate.

For instance, when we accepted an invitation to attend their annual meeting, we went with considerable misgiving and outright skepticism. We expected to meet a gathering of rather brash young slackers who were attempting to capitalize, without any effort of their own, on the professional status which engineers have attained. We even suspected that there might be a trace of the "delinquent" discernable.

We soon found out how wrong our assumptions were. We discovered, for example, that the certified technician group includes some men with more years of engineering experience than we have total years; that many of the group are well on their way, through home study on an individual basis, to registration as engineers; that all of them are interested in improving the status of their group through their own efforts. They are asking no one for special consideration or favors. All they ask is the opportunity to serve their country in their chosen sphere of industry. And there does not appear to be a slacker in the group.

Ontario is the only province in Canada where concerted effort is being taken to recognize the training and qualifications of these technicians and technologists. Most of the other provinces, and many of the states in the U.S.A., are watching events very closely. All engineers should be giving the movement their 100% endorsation. It is certainly a move in the right direction.

STOP PRESS NEWS

Toronto Chapter – Fluid Power Society

The first meeting of this group will be held in the Maclean-Hunter Building, 481 University Avenue, Toronto, on Wednesday, January 25 at 8:00 p.m. A guest speaker from the U. S. will address the meeting. All those interested in Fluid Power technology are welcome. This includes students, users, manufacturers, distributors, engineers.

. . . Become a charter member of the Toronto chapter . . . attend this first meeting . . .

Calling all exporters

In a little over four months the 1961 Design Engineering Show will be with us. This time it will be held in Detroit, where the Canadian Government, as it did in New York and Philadelphia, has reserved space to accommodate the exhibits of manufacturers and an information booth for the Department of Trade and Commerce.

The Detroit display will occupy 2,400 sq. ft., slightly more than in New York last year and more than double the mere 1,000 sq. ft. in Philadelphia in 1959. As in New York, Canada has a choice location on a main aisle; perhaps an even better location than in New York, because this time it's near the main entrance instead of one flight up. Also our Cobo Hall exhibit will be open on four sides, instead of three as at the New York Coliseum.

No companies have as yet made firm commitments, but the department's Foreign Trade Service expects that the exhibit will accommodate the displays of about 20 firms. Last year there were 17 firms and the year before 29, though many at Philadelphia only made a token appearance and failed to man their booths. The probable explanation for their cavalier attitude was that, having got the space free, they didn't appreciate its potential value. Last year the Foreign Trade Service was wiser and charged exhibitors a fee, though only a nominal one.

If you're considering putting your products or services on display, you should write without delay to the Engineering & Equipment Division, Foreign Trade Service, Department of Trade and Commerce, Ottawa. Bear in mind that engineering firms interested in the export market, and with something new to offer, can scarcely do better than exhibit at the Design Engineering Show, a specialized show devoted to products of new and original design. The show is held in conjunction with the annual convention of the American Society of Mechanical Engineers and attracts a registration of 20,000 engineers and designers, who incidentally pay two dollars to get in. Members of the public are not admitted.

The Department of Trade and Commerce, export-conscious as never before, will back you to the hilt if you exhibit, for instance by following up enquiries through the trade commissioner service. In fact, even if you don't exhibit, the department will help you if possible, because all callers interested in specific Canadian products will be directed to the appropriate suppliers, whether the latter exhibit or not. Obviously, though, you have the edge if you're there in person, or if you have a representative on the scene.

Use these cards to get additional information... promptly... conveniently

Every advertisement, new product, and catalogue listed in this issue of DESIGN ENGINEERING has been key numbered.

To secure information and literature just circle the proper number on the cards . . . complete and mail . . . we contact the companies for you and pay all the postage.

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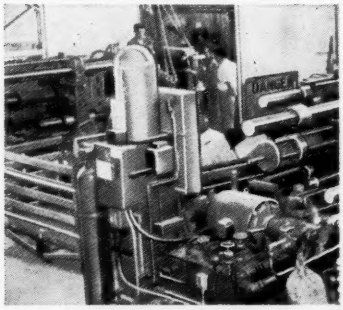
New Facilities
for aluminum die-castings

Modern, precision equipment at Hoover assures top quality and fast delivery

New operational methods and facilities enable Hoover to offer a die-casting service that is second to none. This expansion is reflected throughout the entire Casting Division.

From design-engineering to final inspection the emphasis at Hoover is on modern methods, efficient equipment and careful craftsmanship.



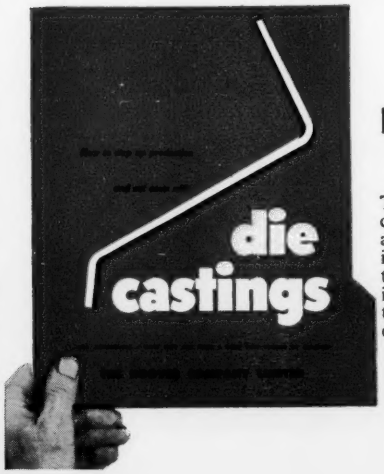
Hoover's die-casting section (above) has machines with ratings up to 600 tons, that can produce aluminum die-castings in quantity from the smallest practical size up to 14″ x 14″.

Trimming, finishing, buffing, machining and painting facilities (partially pictured below) enable Hoover to deliver castings in every state of finish, from "as-cast" to the finest commercial surfaces.

Scientific sampling and thorough testing of finished castings assure consistently high quality and strict adherence to specifications.

When should die-castings be used? There is no simple answer to this question. Generally speaking, die-castings should be used when reduced machining costs, intricate shapes, economy, attractive appearance and durability are factors.

Contact Hoover Die-Casting Division to learn if this precision technique will cut *your* costs.



Send for this
FREE DIE-CASTINGS HANDBOOK

This informative bulletin on aluminum die-casting will guide you in choosing alloys, and in the design of castings. Hints are included to help you take advantage of the die-casting process. You will also be interested in a detailed picture story that traces the production of die-castings from drawing board to final inspection. Write to

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Die-Casting Division,
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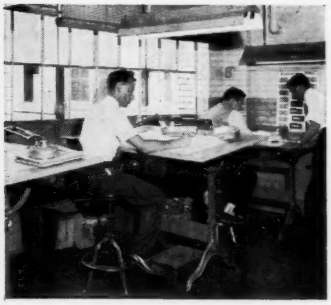
has the DIE-CASTING know-how



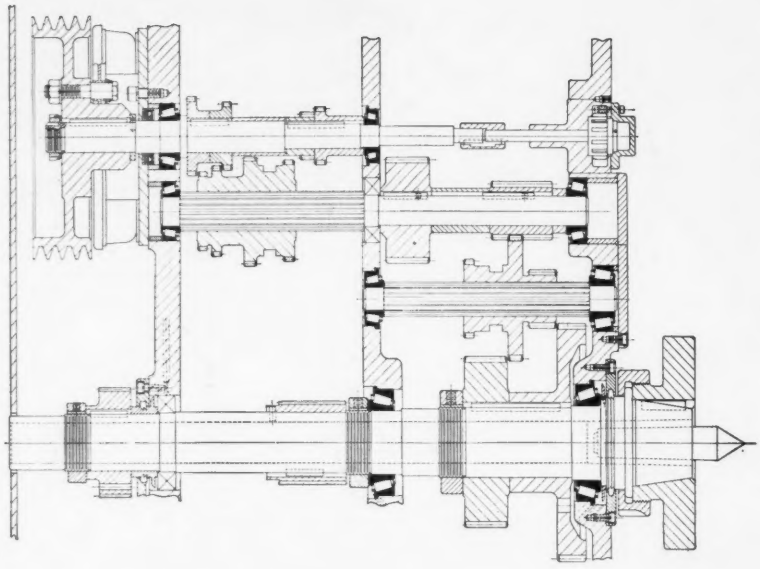
to produce castings at lowest costs

Hoover engineers have a tremendous fund of specialized experience in die-casting. Their knowledge is at your disposal. They welcome the opportunity to discuss your die-casting problems, and to assist in the design of components that will cut your costs and improve your product

HOOVER
DIE-CASTINGS

85-897

LeBLOND lathe obtains super spindle-runout of less than .000025″ with Timken "00" bearings



To raise the already great precision of its 15″ Dual-Drive lathe to a special new high for a customer, LeBlond had to meet this requirement: spherocity of the part to be turned—a beryllium gyro float assembly—had to be concentric with its two major axes within .0005″ total indicated runout. Diameter of the sphere: 1.8750″.

To assure this, LeBlond engineers specified Timken super-precision "00" tapered roller bearings held to .000025″ assembled runout for the spindle—one-third the normal runout tolerance for these bearings. Timken bearings were also used on the intermediate, back and feed shafts of the drive. The assembled spindle runout (total indicator reading) was actually less than .000025″.

Producing super-precision bearings like this is typical of Timken Company service. The kind of service that developed Timken "00" bearings to meet industry's needs for ever-greater precision. It's another example of the Timken Company's leadership in tapered roller bearing design and manufacture.

YOUR BEARING PROBLEMS can often be solved on-the-spot by our graduate engineer salesmen. Working with you at the design stage, they can help you select the Timken bearing to meet your special needs, save you time and money.

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